Toitū te Whenua, Matatū Ana te Wao nui o Tāne:

A Cultural Health Monitoring and Assessment Approach for Indigenous New Zealand Forests

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Toitū te Whenua, Matatū Ana te Wao Nui o Tāne[1]: A Cultural Health Monitoring and Assessment Technique for Indigenous New Zealand Forests

by Dean Patrick Walker

The rights, roles and responsibilities of Māori as kaitiaki or environmental guardians are increasingly being acknowledged in the public sphere in Aotearoa New Zealand. National biodiversity policy and legislation encourages Māori participation in indigenous forest management. For the most part however, current forest policy initiatives and management practices continue to be dominated by Western scientific thinking often at the expense of Māori knowledge systems. Opportunities and tools for engagement in cross-cultural communication between Indigenous and scientific ways of knowing are rare although they are increasing. For cultural information to be effectively relayed it needs to be presented in ways that are reflective of a Māori worldview but at the same time the communication also needs to be coherent to decision makers. Culturally-based monitoring and assessment techniques have proven to be effective at achieving these ends.

Kaupapa Māori and action research methodologies are presented and brought together as complementary methodologies that underpin this thesis. This involved a collaborative approach involving three tribal groups in the Motueka catchment and four mandated kaitiaki to a research team to work alongside the principal researcher. An outcome of the research was the co-creation of a *Ketewhaihua* toolkit for assessing the state of health of indigenous forests from an indigenous Māori perspective. An *Atua* framework, based on ancient Māori cosmology and spiritual guardians, was used to help derive and structure a set of culturally-based environmental indicators and a prototype toolkit. The prototype Ketewhaihua was tested by the research team at six forests sites in the Motueka and Riwaka catchments over four seasons in 2013. Qualitative and quantitative data

[1] The permanence of the land, the enduring forests

were recorded and analysed following each round of forest visits and iteratively used to help improve the performance of the developing toolkit.

The developed Ketewhaihua is culturally robust and technically sound and can be used both for the collection of data as well as a learning tool. The toolkit offers a unique approach in addressing practical problems of managing indigenous forests. The Ketewhaihua provides Māori with a new toolkit to improve both their practice of kaitiakitanga and their participation in the sustainable management of indigenous forests. Knowledge gained will assist tribal groups to provide advice to government authorities, corporates and private entities and to manage indigenous forests in ways of knowing familiar to Māori. Other Indigenous peoples may be inspired to develop similar culturally-based tools to improve the management of their natural resources and assert their rights at the local, national and international levels.

Keywords: kaupapa Māori[2], kaitiakitanga; culturally-based monitoring; sustainable forest management; Atua framework; ako learning, Indigenous peoples; Aotearoa New Zealand.

I te timatatanga ko Te Pū

Nā te pū ko Te More, ko Te Weu

Nā te weu ko Te Aka, ko Te Rea

Nā te rea ko Te Wao Nui

Nā te wao nui ko Te Kune

Nā te kune ko Te Whē

[2] See Papakupu – Glossary of Māori words for interpretations of words and phrases

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Papakupu – Glossary of Māori Words[3]

Ako *also* ako Māori	Pedagogy according to Māori principles
Aotearoa	Māori name for New Zealand
Āta	The principle of growing respectful relationships
Atua	God, supernatural being, deity
Haumietiketike *also* Haumia-tiketike	Deity of fern root and uncultivated food
Hapū	Kinship group, subtribe. Also means pregnant
Hongi	The formality of pressing noses in greeting
Hui	Meeting
Iwi	Tribe
Kahikatea	*Dacrycarpus dacrydioides* - a tall coniferous tree
Kaitiaki	Guardian – may refer to an individual, tribe, deity, species or inanimate representing a spiritual entity. Kaitiaki in the context of this research refers to research team members.
Kaitiakitanga	Guardianship obligations; rights, roles and responsibilities
Karakia	Prayer, incantations
Kaupapa Māori	Māori philosophy, theory, methods, praxis and practice
Kawa	Protocols or primary principles which relate to individual iwi or marae. In the context of this research this term also refers to the protocols or primary principles in the use of the kete whaihua toolkit.
Kāwai tūpuna	Tribal god, literally line of descent, ancestor
Kererū *also* kūkupa	*Hemiphaga novaeseelandiae* - New Zealand pigeon
Ketewhaihua	A toolkit that is fit for the purpose it was designed
Kōhanga reo	Māori preschool language immersion. Literally 'language nest'

[3] Translations provide only an insight into the words or concepts and may not fully describe the depth, interconnectedness and duality of some terms. Hence the use of the symbol ≈ (approximately equal to) rather than = when the translations are referenced in the footnotes.

Kōrero	Narrative, discussion, discourse
Kotahitanga	Unity, collective action, holism
Mahinga kai	Food-gathering place or species harvested
Maire rauriki	*Nestegis lanceolata* - white maire tree
Mana	Power, status, authority
Manaakitanga	Hospitality, support
Mana whenua *also* mana whenua iwi	Those tribe(s) who hold mana over the land or territory
Marae	The open area in front of the meeting house (Marae ātea). Often also used to include the complex of buildings around the marae
Maramataka	Traditional almanac or calendar used to guide planting, harvesting and fishing
Mataī	*Prumnopitys taxifolia* - a coniferous tree of lowland forest
Mātauranga *also* Māori Mātauranga	Traditional and contemporary Māori ways of knowing
Mauri	Life force, the essence of life contained in all things
Mokopuna	Grandchild, grandchildren
Mōteatea	Traditional poetic chants, dirges and laments
Murihiku	Southernmost province of New Zealand, Southland
Ngahere	Forest
Ngāi Tahu *also* Kai Tahu	Southern tribal group
Niho taniwha	Saw-edged or triangular pattern. Literally the 'tooth of the supernatural being'
Papatūānuku *also* Papa	The Earth Mother
Pepeha	Tribal saying or motto, figure of speech
Pīwakawaka *also* Tīwakawaka	*Rhipidura fuliginosa* – fantail bird
Poutiriao	Spiritual guardians
Puku	Belly, stomach

Pūrākau	Traditional narrative, or erroneously “myth or legend”
Ranginui *also* Rangi	The Sky Father
Rimu	*Dacrydium cupressinum* - a tall coniferous tree
Rohe	Tribal territory or district
Rongomātāne *also* Rongo	Deity of peace and agriculture
Rongoā	Medicinal plants, traditional and alternative medicine
Rūaumoko *also* Rūamoko	Deity of earthquakes, volcanoes and geological phenomena
Takiwā	Tribal territory or district
Tāne *also* Tānemahuta	Deity of the forests and birds
Tangaroa	Deity of the sea and inland waterways
Tangata whenua	Those Māori who hold traditional rights and responsibilities over ancestral lands and resources, literally means *people of the land*
Taniwha	Powerful, sometime dangerous, creature, spirit or guardian
Taonga *also* Nga taonga tuku iho	Treasures (tangible and intangible objects and process) passed down from the ancestors
Tapu	Sacred, prohibited, restricted
Te ao Māori	A Māori worldview
Te Tau Ihu (o te Waka a Māui)	The top of the South Island. Literally ‘The prow of Maui’s canoe’
Te Tiriti o Waitangi	The Treaty of Waitangi. The Māori language version of the treaty that was signed between Māori and the Crown in 1840
Teina	Younger relative
Tōtara	*Podocarpus totara* – a tall coniferous tree
Tikanga *also* tikanga Māori	Procedure, custom, method, practice, protocol. In the context of this research tikanga is culturally safe practices that guide researchers
Tino rangatiratanga	Sovereignty, self-determination
Tīpuna matua	Great grandfather

Tīpuna whāea	Great grandmother
Tohu	Signs from the Atua, indicator, guide
Tūmatauenga *also* Tū	Deity of people and war
Tuākana	Elder brother, sister, or senior relative
Tūhoe *also* Ngāi Tūhoe	Tribal group of Te Urewera in the eastern North Island
Tūī	*Prosthemadera novaeseelandiae* - a songbird
Tuna	Freshwater eel of *Anguilla* species and types
Wai	Water
Waiata	Song or chant
Wairua	The spiritual dimension or spirit
Wānanga	Workshop, forum, discussion
Weka	*Gallirallus australis* - a brown flightless bird
Whakatauākī	Attributed saying or proverb
Whakataukī	Unattributed saying or proverb
Whanau	Family group
Whanaungatanga	Relationships, kinships, sense of family connectedness
Whare wānanga	Place of higher learning

Chapter 1

Introduction

> *"All of these indigenous peoples teach us that there are other ways of being, other ways of thinking, other ways of orientating yourself on the earth. And this is an idea if you think about can only fill you with hope"* Wade Davis (2007)[4].

Over the past 40 years protest around the world has grown in response to increasing pressures on local natural resources and negative changes in global ecological processes. This protest has facilitated greater recognition of the rights of Indigenous peoples and their inclusion in national legislation and policy, and international agreements such as the Convention on Biodiversity (UNEP 1992a), The Rio Declaration (UNEP 1992b) and The Montréal Process 1994 (The Montréal Process Working Group 2015b). All of these initiatives recognise the right of Indigenous peoples to participate in the management of biodiversity. The Treaty of Waitangi Act 1974 (NZ Parliament 1975) was a turning point in Aotearoa[5] New Zealand in the recognition of both Te Tiriti o Waitangi[6] as the country's 'founding document' and the rights of Māori guaranteed under the Treaty. The roles and responsibilities of Māori over the management of natural resources have been further affirmed through environmental legislation that has incorporated Māori and the Treaty of Waitangi. These include the Conservation Act 1987 (NZ Parliament 1987), the Resource Management Act 1991 (NZ Parliament 1991) and the Environmental Reporting Act 2015 (NZ Parliament 2015). The WAI 262 report *Ko Aotearoa Tēnei* further recognised Māori rights in respect to flora, fauna and other cultural taonga[7] (Waitangi Tribunal 2011). These rights have continued to be expressed in policy initiatives such as the draft National Policy Statement on Indigenous Biodiversity (Biodiversity Collaborative Group 2018). As a result, there is a growing expectation on Māori to provide Indigenous perspectives on natural resource and biodiversity policy and practice.

[4] Cultures at the Far Edge of the World https://www.youtube.com/watch?v=bL7vK0pOvKI Uploaded on Jan 12, 2007
[5] Aotearoa ≈ Māori name for New Zealand
[6] Te Tiriti o Waitangi ≈ The Treaty of Waitangi. The Māori language version of the treaty that was signed between Māori and the Crown in 1840
[7] Taonga *also* Nga taonga tuku iho ≈ Treasures (tangible and intangible objects and process) passed down from the ancestors

Indigenous knowledge systems are increasingly viewed as important contributors to sustainability conversations and environmental management solutions including opportunities for co-management of biodiversity (Berkes & Folke 1998; Moller *et al.* 2004; Harmsworth *et al.* 2011; Satterfield *et al.* 2013; Lyver *et al.* 2017). In New Zealand, the Waitangi Tribunal in the Muriwhenua[8] fishing report outlined the principles governing the basis for Māori and their relationship with the environment (from James 1993). These principles highlight key attributes of Māori knowledge systems. These principles are italicised, then the author's comments follow.

- *A reverence of the total creation as one whole.* Kaupapa Māori approaches to discovery and the creation of knowledge are often described as holistic and integrated (Marsden & Henare 1992; Harmsworth & Awatere 2013). Western scientific methodologies[9] are usually based on reductionist and empirical approaches with the focus usually on individual parts of a system rather than the whole (Marsden & Henare 1992; Miller 2005)

- *A sense of kinship with all fellow beings. This is illustrated through genealogical ties of all natural resources in the universe.* Te ao Māori[10] understanding of taxonomy through whakapapa includes complex connections of deities, humans, animal, bird and plant species as well as inorganic objects such as minerals and rocks – the animate and inanimate (Clarke 2007; Roberts 2012,2013). In contrast, Western binomial taxonomic systems keep separate the organic, the inorganic and the cosmological. However, prior to the 16th century the Western world had a more holistic view of nature as "God's plan" but as rational, scientific thought began to develop, this view was rejected (Miller 2005)

- *A sacred regard for the whole of nature and its resources as being gifts from the gods.* Māori regard nature as a treasure handed down by the ancestors (Harmsworth & Awatere 2013). The scientist is not obliged to regard biodiversity and natural resources as endowments to be honoured with due care and respect (Miller 2005)

[8] North Cape area of the North Island
[9] 'Western science' is also variously referred to as 'scientific methodologies' and the 'science of the West' Smith, L.T. 2012, *Decolonizing Methodologies: Research and Indigenous peoples*, Second edn, Zed Books, London. . For the purpose of thesis 'Western science' is the favoured term but this does not preclude Indigenous Peoples' identifying their own scientific knowledge systems.
[10] Te ao Māori ≈ A Māori worldview

- *A sense of responsibility for these gifts as the appointed stewards, guardians and rangatira (collectively kaitiaki[11]).* As kaitiaki, tangata whenua[12] inherit non-negotiable kaitiakitanga[13] roles, rights and responsibilities for the management of natural resources (Marsden & Henare 1992; Roberts *et al.* 1995; Kawharu 2000)

- *A distinctive economic ethic of reciprocity. What you take from the environment you return in kind.* Reciprocity is expressed in the practice of *tau utu utu* whereby one is obliged to give back to the environment when one takes from it (Harmsworth & Awatere 2013)

- *A sense of commitment to safeguard all of nature's resources for future generations.* This principle parallels the postmodern sustainability paradigm that promotes intergenerational equity. "*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (World Commission on Environment and Development 1987)

Internationally, other Indigenous voices carry similar themes with expressions of spirituality, holism, integrative nature, long-term connections, kinship, reciprocity and "connections to all things" being commonly cited (Berkes 1999; Moller *et al.* 2004; Miller 2005; Berkes 2009; Jurney & Hoagland 2015). These knowledge systems have developed out of relationships between the Indigene and the environments they intimately inhabit over very long periods of time. Customs and narratives maintain these relationships for purposes of survival and, in turn, for the maintenance of biodiversity and natural resources under their guardianship (Berkes, Colding & Folke 2000; Clark & Slocombe 2009; Jurney & Hoagland 2015). "*Aboriginal knowledge is profoundly contextual and place based, which is quite different from the universalizing tendencies of Western scientific and bureaucratic institutions*" (Clark & Slocombe 2009).

The benefits of Indigenous ways of knowing to the sustainable management of natural resources is recognised however, putting action into practice often presents challenges. Cross-cultural tools have been developed by Indigenous people to collect and present information through their own perspectives in ways familiar to them. These include culturally-based monitoring (CBM) tools. This research seeks firstly to understand and document the epistemological and pedagogical features that underpin a CBM tool for monitoring the health of indigenous forests from an Indigenous Māori

[11] Kaitiaki ≈ Guardian – may refer to an individual, tribe, deity, or an animal representing a spiritual entity. Kaitiaki in the context of this research usually refers to research team member(s).
[12] Tangata whenua ≈ Those Māori who hold traditional rights and responsibilities over ancestral lands and resources, literally means *people of the land*
[13] Kaitiakitanga ≈ Guardianship obligations; rights, roles and responsibilities.

perspective; and secondly how this knowledge can be implemented into a functional tool. The research is covered in eight chapters; Introduction; Literature review of culturally-based monitoring; Theoretical framework; Engagement methodology and case-study forest; Development of the Atua framework and Ketewhaihua; Application of the Ketewhaihua to three forests in the upper Motueka catchment; Discussion; and Conclusion.

1.1 The research partners

This research takes a case study approach with the case study being set in the Motueka and Riwaka catchments in Te Tau Ihu o te Waka a Māui[14] Aotearoa New Zealand. The research partners in the collaboration are three manawhenua iwi[15] groups, Te Ātiawa Manawhenua ki te Tau Ihu Trust[16], Ngāti Tama ki Te Waipounamu Trust, Te Rūnanga o Ngāti Kuia Trust, and four mandated kaitiaki (Pat Park, John (JK) Katene, Maui (Jason) Duff, and Ray Anderson, the principal researcher (Dean Walker) and Lincoln University. A detailed description of the partnership and engagement process is presented in Chapter 4, Section 4.2, *Iwi engagement methodology*.

1.2 Research rationale

The voices of the Indigene often go unheard or are not acted upon – despite the rights, roles and responsibilities of Indigenous peoples being acknowledged through a variety of national and international mechanisms, and the value of their ways of knowing to local and global issues of sustainability. Even when there are legislative mechanisms in place, such as in Aotearoa New Zealand, central government and local authorities have resisted the implementation of such provisions and maintain their hold on power (Morgan 2004). The lack of Indigenous voices in resource management not only has social justice implications, but also compromises the sustainability of natural resources and limits opportunities for improved management of biodiversity.

During the mid-1990s linkages between Indigenous and Western scientific approaches were identified as ways to overcome this lack of voice. In Aotearoa New Zealand formal culturally-based monitoring tools started to be developed to bridge worldviews and make progress in cross-cultural understanding (e.g. Harmsworth 2002a; Tipa & Teirney 2003). These tools often coupled contemporary and traditional mātauranga Māori[17] with scientific frameworks, indicators, and methods (Harmsworth & Awatere 2013; Harmsworth, Awatere & Robb 2016). Armed with

[14] Te Tau Ihu (o te Waka a Māui) ≈ The top of the South Island. Literally 'The prow of Maui's canoe'
[15] Iwi ≈ Tribe
[16] Now called Te Ātiawa o Te Waka-a-Māui Trust
[17] Mātauranga Māori *also* mātauranga ≈ Traditional and contemporary Māori ways of knowing

complementary monitoring tools Māori were increasingly positioned to provide data on the health of the environment from a cultural perspective, both when it was requested by others and when they need to undertake monitoring to meet their own aspirations and goals. However, there are challenges to the development of functioning culturally-based assessment and monitoring approaches. These include the choice of appropriate frameworks, indicators and methods which reflect the world view of those collecting the data, differences in perceptions and experiences of individuals in determining ecological baselines, and resolving conflicts between Western and Māori epistemologies. While the development of culturally-based indicators for assessing environmental health by Māori has progressed, the development of applied field tools has been less so, with monitoring programmes poorly resourced and uncoordinated, and the level of participation by Indigenous groups and communities sporadic (Harmsworth & Tipa 2006; Jollands & Harmsworth 2007; Chetham *et al.* 2010; Harmsworth & Awatere 2013).

Most existing tools available in Aotearoa New Zealand to monitor the health of indigenous forests are Western science-based (Allen, Bellingham & Wiser 2003; Hurst & Allen 2007a,2007b; Allen *et al.* 2009). Some examples use te reo Māori terms (e.g. Handford *et al.* 2004) but are not underpinned by a Māori worldview so at best are good intentioned. A knowledge gap exists in the development of appropriate culturally-based frameworks, indicators, methods and tools for assessing the health of indigenous forests which are rooted in an Indigenous Māori worldview and the application of these in field surveys and monitoring programmes. This research aims to address this gap by complementing and leveraging current literature, proposing an innovative approach that links kaupapa Māori with Western scientific collaborative research methodologies and developing a fit-for-purpose a culturally-based environmental monitoring tool for assessing or monitoring the health of indigenous forests.

1.3 Research questions

This thesis is contextually located within culturally-based monitoring, and the utility of Indigenous frameworks, indicators and metrics. The case is argued that well-designed culturally-based monitoring tools can assist Indigenous groups to participate in and influence the sustainable management of biodiversity and natural resources. The following five research questions are posed:

1. What is an appropriate methodology for the engagement of Māori and scientists in a natural resource management project?

2. From a Māori perspective what is an appropriate framework and suite of culturally-based indicators (tohu) for monitoring?

3. How can culturally-based frameworks and tohu be used in forest assessments?

4. What are the strengths and weaknesses inherent in the use of culturally-based monitoring tools?

5. What are the current barriers and opportunities to the use and development of culturally-based monitoring in New Zealand indigenous forests?

Using a case study approach, involving the three iwi groups and six forests, this project aims to investigate/answer these research questions by (i) Developing a conceptual framework that is rooted in a Māori world view (ii) Identifying a suite of tohu for undertaking assessments of forest health, and (iii) Trialling those tohu at six forest sites, with a view to assessing the implications of these for sustainable forest management policy and how the results may provide deeper understanding of how to converge Māori and Western scientific perspectives in practice.

1.4 Terminology around the field of study

In Aotearoa New Zealand there are several terms that have been used to describe formal environmental monitoring regimes developed by Māori groups to monitor the health of environmental domains using their own frameworks, tohu and tools. Each term places emphasis on a different aspect or aspects of the concept. A description of each term helps to define the overall concept and practice more fully. The earliest work emphasised indicators with *Cultural Health Indicators* being the term used by Gail Tipa and Laurel Teirney in their formative work on rivers in Murihiku[18] (Tipa & Teirney 2003,2006a,b). Garth Harmsworth (2002a) favoured the term *Māori Environmental Performance Indicators* (EPI) in his work on wetlands following a protocol set by the Māori Environmental Monitoring Group (Ministry for the Environment 1998). They defined a Māori EPI as "*… a tohu[19] created and configured by Māori to gauge, measure or indicate change in an environmental locality. A Māori EPI leads a Māori community towards and sustains a vision and a set of environmental goals defined by that community*" (Royal *et al.* 1998). More recently Harmsworth, Awatere and Robb (2016) refer to the concept simply as *cultural indicators*. The Nelson based Māori resource management entity, Tiakina te Taiao, uses the term *iwi indicators* (Passl & Walker 2005) emphasising indicators that are derived from a specific tribal iwi base rather than from a more generic Māori worldview.

[18] Murihiku ≈ Southland – southern most province of New Zealand

[19] Tohu ≈ Sign, indicator, guide

Chetham *et al.* (2010) favour the term *Māori Cultural Environmental Monitoring* which highlights both the activity (monitoring) and the people carrying out the monitoring (Māori) but do not refer to the instruments such as indicators. Ngāi Tahu[20] use the term *culturally-based environmental monitoring* in their State of the Takiwā[21] documents (e.g. Pauling & Mattingley 2007). These terms, like Tipa and Teirney's and Harmsworth's, highlight the cultural side of the concept but do not specifically refer to either iwi or Māori. The terms 'cultural' and 'culturally-based' could be misconstrued to include a local community (culture) that has a long-term relationship with a place, whereas the concept outlined by these authors specifically relates to Māori groups. The inclusion of the term *environmental* can also be problematic, as the holistic nature of te ao Māori does not separate environmental, economic, social and cultural systems but views them as an integrated whole (Marsden & Henare 1992; Miller 2005).

Internationally, *community-based monitoring* is the favoured term for the practice (Danielsen *et al.* 2000; Topp-Jørgensen *et al.* 2005; Garcia & Lescuyer 2008; Gofman 2010; Conrad & Hilchey 2011; Johnson *et al.* 2017), although *locally-based monitoring* (Danielsen, Burgess & Balmford 2005), and *participatory biodiversity monitoring* (Danielsen *et al.* 2003b) are also used. These terms include a spectrum of citizen science environmental monitoring approaches, from non-Indigenous local people using Western scientific frameworks and indicators through to Indigenous people using Indigenous frameworks and indicators they have developed themselves. "Grassroots indicators" was a term put forward by Hambly (1995) and Hambly and Angura (1996) to describe approaches at the Indigenous end of the spectrum, however the term has not gained widespread use.

While each definition has its strengths and weaknesses there is no all-encompassing term. The concept can include indigenous frameworks, activities (assessments / monitoring), methods, the Indigenous people that hold the knowledge and carry out the activity (in New Zealand this is usually mana whenua iwi[22]) and instruments which are used (tools, criteria, tohu and metrics) (Natcher & Hickey 2002; Saint-Arnaud *et al.* 2009; Satterfield *et al.* 2013; Harmsworth, Awatere & Robb 2016). For the purposes of this thesis *culturally-based monitoring* or CBM is the term favoured. It aligns with the international term *community-based monitoring,* with the cultural component signalling that it is carried out by Indigenous people.

Most approaches to culturally-based monitoring adopt or adapt Western scientific methodologies at least as a part of their approach. Such complementary or convergent approaches have the potential

[20] Ngāi Tahu *also* Kāi Tahu ≈ Southern tribal group
[21] Takiwā ≈ Tribal territory or district
[22] Mana whenua iwi ≈ Those tribe(s) who who have authority over land or territory

to maximise the strengths of both approaches, present a wider understanding of complex systems and problems, and conceivably provide more sustainable and enduring solutions both in Aotearoa New Zealand and internationally. The potential of these convergent approaches is the focus of this thesis.

1.5 Ethical and positionality considerations for a Pākeha undertaking kaupapa Māori research

> *"I believe only a Māori from within the culture can do this adequately. Abstract rational thought and empirical methods cannot grasp the concrete act of existing which is fragmentary, paradoxical and incomplete. The way lies through a passionate, inward subjective approach. Only a few alien to a culture, men like James K Baxter with the soul of a poet, can enter into the existential dimension of Māori life. This grasp of culture proceeds not from superficial intellectualism but from an approach best articulated in poetry. Poetic imagery reveals to the Māori a depth of understanding in men which is absent from the empirical approach of the social anthropologist" (Marsden 1992).*

I am a Pākehā scientist working with Māori groups in collaborative research. I am also a poet. Indigenous – Western scientific collaborations are not uncommon in New Zealand (e.g. Lyver & Moller 1999; Kilvington *et al.* 2004; Lyver *et al.* 2008; Moller *et al.* 2009) however, this space is fraught with challenges. Criticism falls on the colonising tendencies of the Western scientific tradition, the appropriation of indigenous knowledge and the justified distrust by Indigenous people of Eurocentric Western approaches to scientific research (Stevenson 1996; Chilisa 2012; Smith 2012). Some do not believe that there is a role for Pākehā in kaupapa Māori research (Barnes 2014). Jones (2012) describes Pākehā involvement in kaupapa Māori research as a 'dangerous liaison' but also acknowledges that the practice is not immutable. Others say that if research is carried out in a way which supports and works for Māori then there is a path forward (Marsden 1992; Wong 2006).

As a researcher working in an Indigenous space I am acutely aware of 'insider/outsider' issues, power differentials, the continuing issues of colonisation and the limitations of Western science. I have an appreciation and understanding of te ao Māori, mātauranga Māori and tikanga Māori[23] as well as experience of working in kaupapa Māori situations. I acknowledge tino rangatiratanga[24] and mana[25] as legitimate statements by Māori of their sovereignty and authority.

[23] Tikanga Māori *also* tikanga ≈ Procedure, custom, method, practice, protocol. In the context of this research tikanga is culturally safe practices that guide researchers
[24] Tino rangatiratanga ≈ Sovereignty, self-determination
[25] Mana ≈ Power, status, authority

My practice has been to immerse myself into a Māori world. From 2001 through to 2011 I worked with Māori groups in Te Tau Ihu[26] in a variety of roles, generally assisting them to improve their ability to practice kaitiakitanga. This provided an opportunity to build trust. Much of the work has been at the 'flax-roots' level including ecological and cultural restoration projects, cultural impact assessments and undertaking monitoring projects. My emersion into kaupapa Māori is, I believe, both consistent with this emerging research approach and can also be viewed as a contribution in practice. Beyond my role as a researcher, I am also involved in the ordinary lives of kaitiaki, as my personal friends.

1.6 Thesis overview

This thesis is composed of eight chapters; this chapter being **Chapter 1** positions the participants, the research and the principal researcher geographically and culturally.

Chapter 2 is a ***Literature review of culturally-based monitoring*** approaches internationally as well as in Aotearoa New Zealand. This provides the key characteristics of CBM and its major components including tohu, frameworks and methods. The chapter concludes with an outline of barriers and bridges to the development of CBM tools and the implementation of programmes. The chapter highlights the knowledge gap and provides the rationale for undertaking this research.

Chapter 3 ***Theoretical framework*** brings together two methodological approaches. Kaupapa Māori and action research provide the theoretical underpinning of this thesis with an original contribution of this thesis being at the intersection of these two methodological approaches.

Chapter 4 ***Engagement methodology and study forests.*** This chapter describes the engagement methodology, the catchment area in which the research took place and, the six case study forests.

Chapter 5 ***Development of the Atua[27] framework and Ketewhaihua[28] development*** covers, the development of an Atua framework, a suite of tohu and a prototype monitoring toolkit, followed by the application of the developed toolkit to three forests including challenges faced, concluding with an evaluation of the research practice against nine convergent kaupapa Māori evaluation criteria.

[26] Te Tau Ihu *fully* Te Tau Ihu o te Waka a Māui ≈ The top of the South Island. Literally 'The prow of the Māui's canoe'
[27] Atua ≈ God, supernatural being, deity
[28] Ketewhaihua ≈ A toolkit that is fit for the purpose it was designed

Chapter 6 ***Application of the Ketewhaihua to three forests in the Upper Motueka catchment*** covers the results of cultural health assessments of the three forests by kaitiaki carrying out semi-structured interviews of forest-holders[29] using the fully developed Ketewhaihua toolkit.

Chapter 7 ***Discussion.*** In this chapter the validity of the Ketewhaihua as a complementary Indigenous – Western science forest assessment tool, considerations in regards to it implementation and the wider implications of this research are discussed.

Chapter 8 ***Conclusion*** ends the thesis with a summary of the contribution of this thesis to the culturally-based monitoring space, strengths and weakness of culturally-based approaches, current barriers and opportunities for the uptake of the Ketewhaihua, and finally recommendations for further research, based on key findings in this research.

[29] The term 'forest-holders' is used throughout this thesis. This refers to those people who hold the forestry rights and responsibilities over the property, as opposed to landholders who may not necessarily hold these rights

Chapter 2

Literature review: Culturally-based monitoring

"*There is a certain wild berry tree (called Moretlwa), which bears fruits twice in a year (we call this Moretlwa wa ntlha). If the tree bears fruits from November to early December in a given year before the advent of the rains [first rainfall], this portends that there would be a low rainfall in that year. However, if the tree bears fruits around February/March (we call this Moretlwa wa bobedi), it shows that there will be plenty or more rainfall in that year. But in a situation where the tree bears no fruits at all, this portends a serious danger*" (Dare Kolawole *et al.* 2012). Traditional farmers of the Semboyo community in the Okavango Delta of Botswana use this indicator to help make decisions regarding the type of crops to be planted each year.

2.1 Introduction

Humans are monitors by nature. It is the essence of the hunter, the gatherer, and the agriculturalist alike, making observations and comparisons between species and abundance, between seasons and years. Our survival as a species has depended on it. To some Māori the blossoming of ti kouka trees marks the start of the snapper fishing season. Profuse flowering forecasts an abundance of fish for the season ahead (Walker 2009). To the Mikisew Cree First Nation hunters of north-eastern Alberta the relative size of beaver lodges is an indicator of impending winter conditions. If the lodges are small this signals a cold winter, if they are large this signals a warmer winter ahead. This, in turn, helps Mikisew hunters predict seasonal caribou migration routes and appropriate hunting strategies (Bruce MacLean, Mikisew Cree and Athabasca Chipewyan First Nations Community Monitoring Program, personal communication, 2011).

In these turbulent times, the epoch of the Anthropocene, the rights, roles and responsibilities of Indigenous Peoples in the management of natural resources are increasingly being recognised. This includes their roles as cultural and environmental monitors. Their ways of knowing and managing social-ecological systems carry insights that are complementary to Western science (Tengö *et al.* 2017). Indigenous – Scientific collaborations to environmental monitoring are an expression of this recognition. Under the right circumstances complementary approaches can be simple, robust and inexpensive, essentially sustainable. They can also be effective in strengthening local management of resources and dealing with threats to biodiversity (Danielsen *et al.* 2003a; Moller *et al.* 2004;

Danielsen, Burgess & Balmford 2005). Culturally-based monitoring (CBM) is an example of a complementary approach increasingly being applied today in natural resource settings.

For the purposes of this research CBM is defined as formal monitoring undertaken by Indigenous people from their own worldview to gauge, measure or indicate changes in the health of biodiversity, natural resources and their relationship with people and these resources. It is carried out in the place where the community lives, using their own methods, and is based on a vision defined by themselves. It is similar to community-based monitoring (Gofman 2010; Conrad & Hilchey 2011; Johnson *et al.* 2017; Lyver *et al.* 2017) but it is specific to Indigenous people.

The key characteristics of CBM are not always given conscious consideration or are only considered individually as parts when building practical and robust monitoring CBM tools. Issues of power (Agrawal 2002; Smith 2012; Awatere *et al.* 2013), cross-cultural communication (Metge & Kinloch 1978; Williams 1997) and conceptual differences (Marsden & Henare 1992; Miller 2005) exacerbate Indigenous Peoples' participation and engagement in environmental monitoring.

The purpose of this literature review is to provide an overview of the accumulated body of knowledge around culturally-based monitoring (CBM). It is a general review across a range of ecosystems and continents. Firstly, the main types, characteristics and benefits of CBM are described differentiating it from other types of participatory approaches to environmental monitoring. Examples are then provided from an international context which includes examples of indicators, frameworks and methods. Then the view switches to Aotearoa New Zealand where the state of CBM is highlighted. This is followed by barriers and bridges to the participation of Indigene in CBM programmes. Finally, the review is concluded with the lessons that have been learnt, followed by opportunities and challenges for future research. This review identifies knowledge gaps in the literature and provides insights into answers to the research questions outlined Chapter 1.

In terms of the knowledge review methodology, this involved; (i) Connecting with some of the key academics and Indigenous practitioners, both nationally and internationally, by phone and email to gain their perspectives on CBM (ii) An electronic literature search undertaken mainly using *Google Scholar* and Lincoln University's *LibrarySearch* search engines (iii) Utilisation of hard copy references from Lincoln University and Nelson Marlborough Institute of Technology libraries.

Search phrases used in the literature review included: Indigenous Peoples; Indigenous knowledge (IK); mātauranga Māori; culturally-based, community-based, environmental monitoring, cultural health indicators; tohu; and indigenous monitoring. Key words included, Māori; kaitiakitanga;

biodiversity; environmental; ecological; forest(s); assessments; monitoring; survey; frameworks; instruments; criteria; indicators; metrics; methods; and tools.

2.2 Characteristics and benefits of culturally-based monitoring

A universal feature of Indigenous people around the globe is their connection with 'place' observing and interacting with a local environment often for centuries, if not millennia. A strong environmental ethic has typically developed over time to sustain that existence, along with accumulated bodies of knowledge and community processes (Huntington 1998; Richardson 2001; Jollands & Harmsworth 2007; Kingi, Wedderburn & Montes de Oca 2013). Indigenous worldviews are typically informed by overt values and belief systems. They emphasise features such as spirituality, holism, connectivity and traditional narratives (Berkes 1999; Moller *et al.* 2004; Miller 2005; Berkes 2009; Jurney & Hoagland 2015). Māori culture puts spiritual and communal matters ahead of material and individualistic needs (Williams 1997). Berkes (1999) calls these ways of knowing traditional ecological knowledge (TEK), defining TEK as "*the cumulative body of knowledge, practice, and belief, evolving by adapting processes and handed down through generations by cultural transmission about the relationship of living things (including humans) with one another and with their environment*". It is also referred to in the literature as traditional knowledge (TK), Indigenous ecological knowledge (IEK) and Indigenous knowledge (IK). IK is presented as a broader more holistic concept, rather than confined to knowledge around local ecology, so probably better reflects the multiple worldviews that underpin Indigenous knowledge systems (Rotarangi & Russell 2009; Bohensky & Maru 2011). In this thesis this knowledge is simply referred to as Indigenous knowledge with a capital 'I', as is its compadre, Western science with a capital 'W'.

The value of Indigenous knowledge, in the management of biodiversity and natural resources is increasingly being recognised internationally (e.g. Berkes, Colding & Folke 2000; Richardson 2001; Moller *et al.* 2004; Gilchrist, Mallory & Merkel 2005; Miller 2005; Sherry *et al.* 2005; Brown *et al.* 2006; Kerins, Lennon & Liddy 2006; Jollands & Harmsworth 2007; Prober, O'Connor & Walsh 2011; Danielsen *et al.* 2014; Jurney & Hoagland 2015; Tengö *et al.* 2017). This recognition has led to increased participation by Indigene in mainstream NRM initiatives. This is being expressed, utilising participatory approaches and programmes, often within co-governance and co-management arrangements (Taiepa *et al.* 1997; Moller *et al.* 2004; Te Rūnanga o Ngāi Tahu 2005; Stevenson 2006; Tipa & Welch 2006; Prober, O'Connor & Walsh 2011; Harmsworth, Awatere & Robb 2016). Worldwide, Indigenous peoples are engaging in monitoring, surveillance and the assessment of the health of a wide range of natural resources (Harmsworth & Tipa 2006; Danielsen *et al.* 2007; Awatere & Harmsworth 2014; Johnson *et al.* 2017). Indigenous approaches can provide holistic

perspectives to environmental monitoring that scientific approaches currently struggle with (Harmsworth 2002b; Adam & Kneeshaw 2008).

Prior to the mid-1990s Indigenous Peoples' participation in formal monitoring regimes was minor, if they were involved at all. Indicators of environmental health or sustainable development utilised were mostly scientific in nature. Programmes were typically designed externally and then adapted for local or national use. There was little recognition of locally generated indicators utilised by Indigenous people. The possibility of using local people in the collection of data was rarely considered, even to reduce cost and time demands on scientists (Hambly 1995; Hambly & Angura 1996). Hambly and Angura (1996) were highly critical of the typical participatory processes advocated by donor agencies undertaking research. They found that the predominant use of 'top-down' tools and scientific macro-indicators were deficient in assessing progress towards sustainable development resulting in considerable and general dissatisfaction (Hambly & Angura 1996).

Many participatory approaches are top-down and not directed at assessing the health or sustainability of ecosystems at the local scale from the perspective of local or Indigenous Peoples (Hambly & Angura 1996; Danielsen *et al.* 2003a; Garcia & Lescuyer 2008). Garcia and Lescuyer (2008) found that toolsets and monitoring regimes are generally developed and deployed by external operators and have minimal long-term benefits to the local people. Even where approaches have been developed or adapted specifically for the local level they often still fail to address the values and needs of Indigenous cultures (Danielsen *et al.* 2003a; Garcia & Lescuyer 2008). Such programmes often fail to acknowledge the worldview of the Indigenous communities involved, or their tribal goals and aims. Top down approaches can be seen as a continuation of the colonisation project, a continuation of the colonisation of the minds of the Indigene from outsiders (after Smith 2012). When the funding by the donor agencies ceases, so often does the enthusiasm of the locals for the monitoring project (Danielsen *et al.* 2003a; Garcia & Lescuyer 2008). Further, "*Most programmes are unable to contribute to biodiversity conservation because they are ineffective at integrating information into decision making*" (Danielsen *et al.* 2003a).

New decolonising approaches to sustainable development and arresting environmental degradation, which emphasise the importance of including local knowledge systems are called for. As an alternative bottom-up planning approach to environmental monitoring, Hambly and Angura (1996) introduced the term "grassroots indicators" which are "*formulated by individuals, households, and communities, using their local systems of observation, understanding, and practice, and often involving indigenous knowledge*". Under grass-roots approaches monitoring goals and aims are set by the Indigene, and they incorporate Western scientific methodologies into their ways of knowing if

they want to. In the development of grassroots indicators Hambly and Angura (1996) stressed the importance of cosmology and language. Hambly (1995) made recommendations on the establishment of a grassroots indicators network and, a protocol for research and networking activities on grassroots indicators. However, the term 'grass-roots indicators' did not gain widespread use. Despite this, the involvement by Indigenous peoples in environmental monitoring has burgeoned. Examples can be found in Africa (Hambly & Angura 1996; Topp-Jørgensen *et al.* 2005), Asia (Mantjoro 1996; Burford de Oliveira 1999; Burford de Oliveira *et al.* 2000; Danielsen *et al.* 2000; Fernandez-Gimenez 2000; Baird & Flaherty 2005; Danielsen *et al.* 2007), South America (Noss, Oetting & Cuéllar 2005; Luzar *et al.* 2011), North America (McDonald, Arragutainaq & Novalinga 1997; Ferguson, Williamson & Messier 1998; Hellier, Newton & Gaona 1999; Legat *et al.* 2001; Natcher 2001; Natcher & Hickey 2002; Sherry *et al.* 2005; Adam & Kneeshaw 2008; Saint-Arnaud *et al.* 2009; Gofman 2010; Johnson *et al.* 2017) and Australasia (Moller *et al.* 2004; Harmsworth & Tipa 2006; Jollands & Harmsworth 2007; Kennedy & Jefferies 2009a; Nelson & Tipa 2012; Dobbs *et al.* 2015; Sheil, Boissière & Beaudoin 2015; Harmsworth, Awatere & Robb 2016).

A typology of five monitoring categories typed by their degree of local community participation, has been described by Danielsen *et al.* (2009). These range from top-down approaches with no local involvement where monitoring is undertaken by professional researchers, through to bottom-up approaches where monitoring tools and programmes are entirely designed and undertaken by local people. The types are characterised by who initiates and drives the monitoring, and who undertakes and controls the programme. Their categories are as follows:

1: Externally driven, researcher-executed monitoring with no involvement of local people

2: Externally driven monitoring with local people as data collectors

3: Collaborative monitoring with external data interpretation

4: Collaborative monitoring with local data interpretation

5: Autonomous local monitoring without any involvement of external scientists.

Category 4 is described as "*Locally based monitoring schemes involve local stake-holders in data collection, interpretation or analysis, and management decision making, although external scientists may provide advice and training*" (Danielsen *et al.* 2009). They cite examples in Asia, Africa and Central America but curiously only one in a developed country – the Neighbourhood Nestwatch Scheme in Washington, D.C.

Category 5 approaches are described as, "*the whole monitoring process—from design, to data collection, to analysis, and finally to use of data for management decisions—is carried out autonomously by local stakeholders. There is no direct involvement of external agencies, except possibly to help advocate the continued relevance of such schemes*" Danielsen *et al.* (2009). They provide examples in developed countries, primarily in New Zealand and the Canadian Artic (e.g. Ferguson, Williamson & Messier 1998; Moller *et al.* 2004). There will undoubtedly be examples of Indigenous People informally monitoring their environment in Indigenous ways but typically these will not find their way into academic print, particularly where they operate within semi-subsistence economies unaffected by substantial environmental issues (Berkes 1999).

Danielsen *et al.* (2009) found that Category 5 approaches rated poorest across the five categories in terms of measures of accuracy and precision, and the ability to inform national and international monitoring obligations. In terms of promptness of decision making and the potential for enhancing local stakeholder capacity, category 4 and 5 approaches rated the highest. A challenge here is the development of more useful tools which can better inform monitoring obligations.

These five categories can be can also be neatly aligned along the 'spectrum of engagement' approach defined by the International Association for Public Participation (IAPP). This spectrum comprises: informing, consulting, involving, collaborating and empowering (Glackin & Dionisio 2016). CBM approaches closely align with categories 4 and 5 of Danielsen *et al.* (2009) typology and IAPP engagement models which focus on collaboration and empowerment.

Another way to explore the characteristics of CBM is to compare Indigenous and Western scientific approaches to monitoring. Moller *et al.* (2004) highlight areas of complementarity between science and traditional ecological knowledge for population monitoring. In brief they found

> (i) Western science is good at collecting short time series data over large areas, while Indigenous knowledge focuses on long time series often in smaller areas,
>
> (ii) Western science is usually focused on collecting numerical data as averages whereas holders of Indigenous approaches are exceptionally good at observing extreme events, variations, and unusual patterns,
>
> (iii) Western science utilises quantitative data to understand parts of the system; Indigenous approaches strive for a qualitative understanding of the whole,
>
> (iv) Indigenous approaches provide for better hypotheses, whereas Western science addresses mechanisms (i.e. the 'why' question), and

(v) Western science strives to be objective, excluding people and feelings. Indigenous approaches explicitly include people, feelings, relationships, and sacredness.

Using the two approaches together takes advantages of their relative strengths, provides more complete information, delivers a greater understanding of complex systems, and allows for a stronger link between science and community, producing "science with a heart." (Moller *et al.* 2004)

Danielsen *et al.* (2014) found a strong correlation between results of environmental monitoring by trained scientists and community members using similar methodologies, across 34 tropical forest sites across four countries over 2.5 years. The greatest match in results between the two groups of observers was in instances when the same area and route was surveyed and the time interval between comparative surveys was short. Observations of strong linkages between cultural and scientific indicators of river and stream health have also been noted in New Zealand (Townsend *et al.* 2004; Harmsworth *et al.* 2011). As reiterated by Harmsworth *et al.* (2011) "*The approaches differ in the epistemologies they are founded on, their underlying methodology, their purpose, what they record and measure, and how that information is analysed and interpreted. However, they have enormous potential for articulating two world-views (perspectives) of river and stream health together, and on which to base future goals, objectives, defined standards and policy. Collaborative assessment approaches result in shared learning that has both environmental and social benefits (Roux et al. 2006)".*

2.3 Indicators, frameworks and methods

The key features of CBM identified include; indicators, frameworks, and methods. Articles in the literature on participatory monitoring frequently cover only one or perhaps two features. All three are outlined next in this section. Within the literature the terms 'monitoring' and 'indicators' are often used interchangeably. To be clear in this thesis monitoring is the method and practice of collecting data; it is a process. Whereas, indicators are signs which can be observed through all of the senses, and on which data can be collected.

2.3.1 Indicators

Ecosystems are complex which presents many challenges for monitoring their health. It is not possible to assess the health of all attributes at all scales so representative samples are required in order to gain a picture of the state of environmental health of an ecosystem. Indicators are commonly used by both CBM and non-CBM approaches to monitoring. There is not an agreed upon definition for the term indicator, however a reoccurring theme in the discourse around monitoring is that of signs. "*Environmental indicators condense information about conditions and trends in*

attributes of the natural world. Indicators are generally understood to be "signs" that point out, or stand for, something. They provide clues about the condition or viability of a system or the state of its health" (UNEP 2006). Indigenous Peoples also refer to signs. Jefferies and Kennedy (2009b) describe tohu (indicators) as signs or omens, used by Māori as an important means for interpreting and managing their natural environment. Pikangikum elders of Whitefeather Forest in Canada speak of the process of 'reading the signs' as a teaching. "*The elders still practice this teaching, we listen and watch the land, the Creator shows us the way things are. We know the time without a watch, we watch the weather, and read the snow. This is how we know what to expect and we will be prepared*" - Elders Charlie Peters and George B. Strang (Feb. 16, 2006) in Shearer, Peters and Davidson-Hunt (2009). The shared concept of indicators as signs is fertile ground for understanding between Indigenous and Western traditions.

Indigenous peoples use indicators to monitor the health of their environment and the resources provided by their environment. Indicators and monitoring are particularly associated with harvest and hunting (Moller *et al.* 2004). Indigenous peoples tend to use culturally-based indicators as an assessment of cultural condition in addition to that of biodiversity and resource condition. An assessment of the health of an ecosystem necessitates an assessment of the health of the Indigenous community because they do not disassociate culture from environment (Adam & Kneeshaw 2008). Cultural practices and traditional food systems of Indigenous peoples has been eroded worldwide (Woodley *et al.* 2009). Indigenous people are increasingly conscious of the need to engage in policy development and decision-making to halt this erosion and restore the health where needed. Culturally-based indicators and monitoring approaches are increasingly being used to gather good, reliable data to support their positions (*ibid*).

Problems with scientific indicators have been emphasised. Vos, Meelis and Ter Keurs (1999) point to relational, conceptual and efficiency difficulties in searching for appropriate indicators. There is often a lack of justification behind the choice of any given indicator, with the reasons for the choice not being made explicit (Siddig *et al.* 2016). The UNEP (2006) and the Columbia Basin Rural Development Institute (2013) highlight other limitations of environmental indicators, these being:

- "*there is danger in oversimplifying complex systems,*
- *they may be misinterpreted by the reader,*
- *if there is a correlation between indicators, it may not equal causation,*
- *indicators may be developed to serve the interests of the organization that develops them,*
- *indicators may be chosen based on the availability of data rather than the usefulness or appropriateness of the indicator, and*

- *indicators are often developed to report on environmental issues within political boundaries (usually Federal or Provincial) rather than ecological units*"
  (CBRDI 2013)

The term indicators is often ambiguous and has different meanings in different contexts therefore, it is important to provide purpose and context around indicators (Heink & Kowarik 2010; CBRDI 2013). The purposes of the activity should be outlined, gaps in knowledge should be discussed, indicators be interpreted, linkages highlighted, and conflicts of interest disclosed (CBRDI 2013). Indigenous people typically bring holistic and interconnected perspectives to NRM (Williams 1997; Jurney & Hoagland 2015), so they may better provide solutions to some of the limitations of scientific environmental indicators, even challenge some of these limitations. As an example, the CBRDI warn that a limitation of indicators is that these may be misinterpreted. However, CBM approaches are inherently subjective so misinterpretation of indicators is not a limitation provided they are discussed and debated.

2.3.2 Frameworks

Models and frameworks are cognitive or sometimes pictorial expressions of worldviews. They can be used to assist in the selection and arrangement of indicators in monitoring projects and the design of tools. They can illustrate an overall vison of the monitoring goals. In this section, firstly the Western 'sustainable development' framework is described and examples of where the framework is utilised in monitoring programmes are provided. Then a typology of Indigenous frameworks is introduced along with examples developed by Indigenous groups and how these do, or could, frame Indigenous monitoring projects or tools.

Prominent in Western thought is the 'sustainability framework' or rather a family of sustainability frameworks. An illustration of a sustainability framework first appeared in an article on sustainable development by Barbier (1987) in the same year as the World Commission on Environment and Development (1987) report *Our Common Future*. Figure 1 illustrates a 'sustainable development' framework commonly found in the literature – both scientific and popular – composed of three dimensions or systems; environmental, social and economic. The boundary space where all three dimension overlap is where sustainable states are 'achieved'. The framework has since been expanded to include cultural, political and technical dimensions.

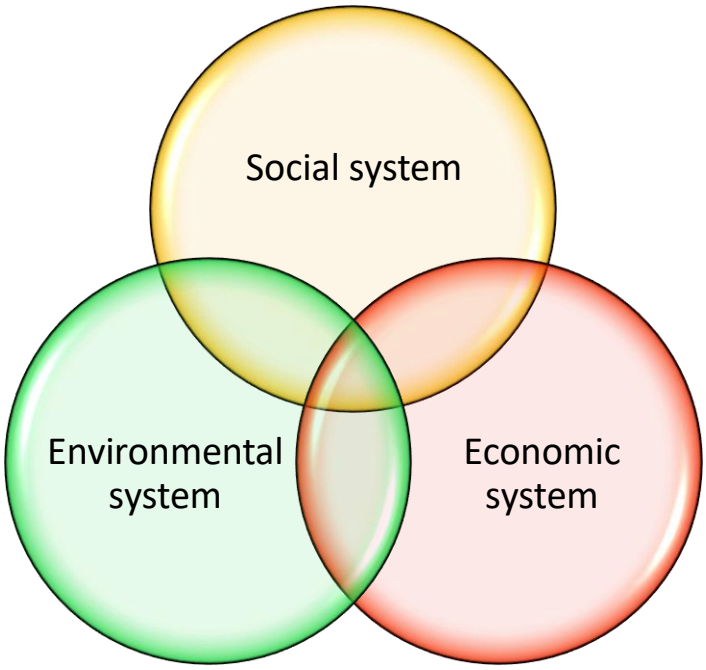


Figure 1: Sustainable Development framework after Edward Barbier (1987).

As well as the Venn diagram versions, nested versions have been developed with a different emphasis on each dimension, typically with the economic system within the social system which in turn is within the environmental system. Sustainability illustrated in terms of a framework has benefits over definitions of the concept. It allows for interpretation, different ways of knowing and encourages debate. Many contemporary monitoring approaches and applications draw on sustainability frameworks for more holistic state of health assessments of complex systems. Sustainability frameworks can help visualise a mix of cultural, social, political, economic and biological relationships for more encompassing assessments (Imbach *et al.* 1997; Prabhu, Colfer & Shepherd 1998; Guijt, Moiseev & Prescott-Allen 2001; Mendoza *et al.* 2003; OECD 2003b,a; Hughey *et al.* 2004).

Three examples of sustainability frameworks are The *IUCN Sustainability Assessment Method* (SAM) (Guijt, Moiseev & Prescott-Allen 2001), The IUCN *Approach to Assessing Progress Toward Sustainability - Tools and Training Series* (Imbach *et al.* 1997; Lee-Smith 1997), and the *Pressure-State-Response* (PSR) framework (OECD 2003a,b; Hughey *et al.* 2004). All three frameworks occupy the socio-ecological boundary space, where human social well-being and ecosystem health overlap. The SAM method has been used to review the relevance, effectiveness, efficiency and impact of IUCN's work at project, programme and organizational levels. The IUCN *Approach to Assessing Progress Toward Sustainability* has been developed for similar levels including the development of tools such as 'community-based indicators' (Lee-Smith 1997). The PSR framework was designed to

be used at the national, international and global decision making levels, but may also be used to develop indicators at subnational or ecosystem levels (OECD 2003b). The PSR has flaws, as the OECD itself highlights, with linkages between the environment and the social, and the social and economic dimensions of sustainable development not being adequately covered (OECD 2003b).

Criteria and Indicators (C&I) for Sustainable Forest Management (Prabhu, Colfer & Shepherd 1998) is a popular sustainable development framework used for monitoring the state of forest health. C&I monitoring frameworks can provide "*for participatory monitoring which leads to knowledge exchange, joint learning and knowledge development*" (Burford de Oliveira 1999). C&I frameworks are used across a variety of countries in a variety of contexts. The Montréal Process is an international agreement that utilises a C&I framework for assessment of the conservation and sustainable management of temperate and boreal forests (The Montréal Process Working Group 2015a,b). Signatories to this agreement supply data in relation to their country's performance on sustainable forest management measured across a common set of seven criteria and 67 indicators (Ministry of Agriculture and Forestry 2009; Ministry for Primary Industries 2013). The Montréal Process signatories are mainly developed countries, although the C&I framework has also been tested and applied in the Philippines (Danielsen *et al.* 2003a; Danielsen *et al.* 2003b; Danielsen *et al.* 2007), Zimbabwe (Mendoza *et al.* 2003), Cameroon, Indonesia and Brazil (Burford de Oliveira 1999; Burford de Oliveira *et al.* 2000). A C&I approach has been developed by the Canadian Government to monitor crown-owned forests (Canadian Council of Forest Ministers 2006) and is also popular with Canada's First Nations peoples, with a First Nations C&I guidebook being developed (Karjala, Sherry & Dewhurst 2003). Some tribal groups in North America have adapted and developed their own sets of tribe-specific C&Is of local forest and community sustainability (Natcher 2001; Natcher & Hickey 2002; Saint-Arnaud *et al.* 2009).

While sustainability frameworks are commonly used to support monitoring initiatives, Gibson (2006) contends that sustainability assessment approaches that separate ecology, politics, society, economics and culture into different categories, tend to perpetuate fragmentation rather than promote integration. He proposes a bottom-up approach that concentrates attention on the identification of public issues such as socio-ecological system integrity, livelihood sufficiency and opportunity, intergenerational equity and priority setting processes, rather than a focus on the 'pillars of sustainability'. Some Indigenous groups have challenged the use of sustainability frameworks and have instead developed their own frameworks based on their own way of knowing (Saint-Arnaud *et al.* 2009; Shearer, Peters & Davidson-Hunt 2009). As an example, a framework has been developed by the Hauraki Māori Trust Board (2004) to structure their environmental

management plan *Whaiā te Mahere Taiao a Hauraki*. The spiritual guardians Ranginui[30], Papatūānuku[31], Tāne Mahuta[32], Tangaroa[33], and Rongomātāne[34] form the basis to Hauraki's vision for resource management (Figure 2).

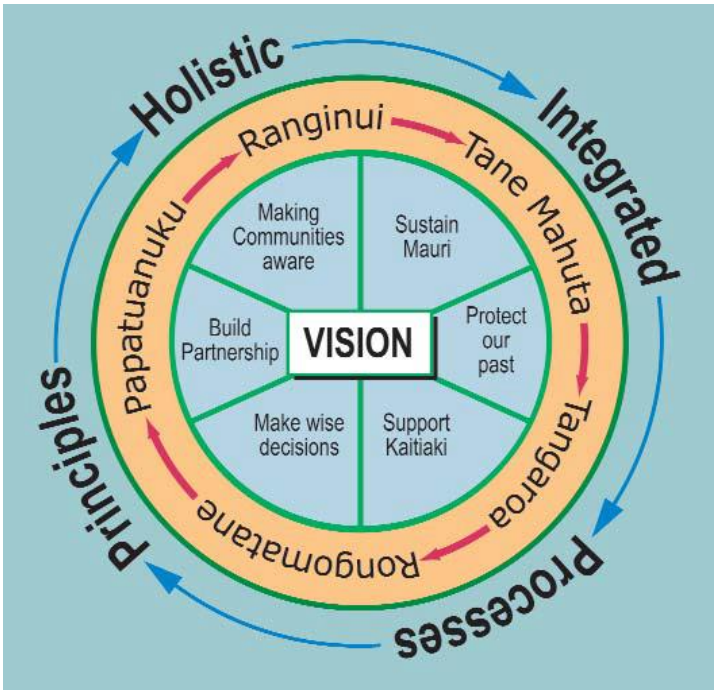


Figure 2: Vision framework for Whaiā te Mahere Taiao a Hauraki: Hauraki Iwi Environmental Plan (Source: Hauraki Māori Trust Board, 2004 (with permission (2012))

Papatūānuku represents place, land and people and Ranginui deals with issues to do with air. Tāne Mahuta responsibilities are forests and birds. Tangaroa has two personifications, one is concerned with freshwater (Tangaroa rerenga wai Māori) and the other with the sea (Tangaroa rerenga wai tai). Rongomātāne covers cultural heritage use of plants, animals and minerals.

Jefferies and Kennedy (2009a) identified three types of Indigenous models used in the resource management space in New Zealand today. These are the cosmological (Atua-based) such as in Figure 2 above, the classification of time (Wā-based) and the tikanga (values-based) models. Some Indigenous groups mix these typologies developing hybrid frameworks. The Pikangikum First Nation at Whitefeather Forest in North-Western Ontario have co-created their own unique 'cultural landscape framework' for monitoring (Shearer, Peters & Davidson-Hunt 2009). The dual purposes of

[30] Ranginui ≈ The Sky Father
[31] Papatūānuku ≈ The Earth Mother
[32] Tānemahuta *also* Tāne ≈ Deity of forests and birds
[33] Tangaroa ≈ Deity of the sea and inland waterways
[34] Rongomātāne also Rongo ≈ Deity of peace and agriculture

this values-based framework is to be representative of the tribe's worldview and to enhance cross-cultural understanding. The framework has four main themes, these being (in English): (i) authority, (ii) cultural revitalisation, (iii) well-being, and (iv) good relationships (Shearer, Peters & Davidson-Hunt 2009). The Anicinapek people of Kitcisakik in Quebec have also developed a values-based framework which represents their worldview of the forest (Saint-Arnaud *et al.* 2009). They used this framework to inform the development of a criteria and indicators tool consisting of five principles: (i) cultural, (ii) ethical, (iii) ecological, (iv) educational and (v) economic. The tool was developed to be used for monitoring the health of their forests and improve their ability to engage in forest certification programmes however, published results from forest surveys have not be located.

2.3.3 Methods

Indigenous people who are engaged in environmental monitoring typically utilise or adapt Western scientific methodologies (e.g. Burford de Oliveira 1999; Burford de Oliveira *et al.* 2000; Natcher & Hickey 2002; Karjala, Sherry & Dewhurst 2003; Sherry *et al.* 2005; Brown *et al.* 2006; Adam & Kneeshaw 2008; Saint-Arnaud *et al.* 2009). The Menominee Tribe of Wisconsin, USA, for example, have developed a continuous forest inventory (CFI) forest monitoring system that can be described as science-based with an Indigenous values focus (Trosper 2007; Waller & Reo 2018). Such an approach is typical in North America and forest monitoring by Native American groups continue to rely on more or less Western approaches (David Natcher, University of Saskatchewan, personal communication*,* 2011). Indigenous peoples trained in the use of Western environmental monitoring tools in North America are becoming more common particularly in cases associated with the mining industry. In Canada, the British Columbia Aboriginal Mine Training Association is involved in the training of First Nation peoples in environmental monitoring[35]. In Australia, programmes, such as Working on Country, have led to the incorporation of Indigenous knowledge into management and improved environmental and cultural outcomes on land and water (State of the Environment 2011 Committee 2011). While environmental monitoring often forms part of these programmes, like their North American counterparts, invariably operate within science frameworks, using Western scientific methodologies. The West Arnhem Land Fire Abatement (WALFA), as an example involves collaboration between Aboriginal people and scientists monitoring carbon-dioxide emissions as part of international greenhouse gas offset agreements (Leonard Cohen, Aboriginal elder, personal communication, 2011*)*.

[35] http://www.bcamta.ca/programs-services/aboriginal-environmental-monitoring

Methods utilised by Indigenous groups usually employ standardised techniques that follow normal scientific requirements for objectivity and repeatability (Danielsen *et al.* 2007). They include species lists, transects, quadrats, patrol records, photography, and discussion groups providing a mix of quantitative and qualitative data. Quantifying, sometimes intangible, cultural values to numbers is problematic. "*Such practices may yield quantitative results but these risk being so stripped of meaning as to misrepresent the cultural values under consideration*" (Satterfield *et al.* 2013). Their suggestion is to make better use of qualitative methods. Incentives, such as payments to locals to collect data, and a process of validation by the community of the research are often included in collaborative and participatory approaches to monitoring (Hellier, Newton & Gaona 1999; Danielsen *et al.* 2000; Noss, Oetting & Cuéllar 2005). Such initiatives have been promoted as being simple, cost effective, sustainable, transparent, and build capacity, knowledge, networks and training within Indigenous communities. They can stimulate discussions on natural resource trends and threats at the community level (Danielsen *et al.* 2000; Danielsen, Burgess & Balmford 2005; Topp-Jørgensen *et al.* 2005; National Institute of Water and Atmosphere 2010).

2.4 Culturally-based monitoring in Aotearoa New Zealand

Culturally-based monitoring is actively practiced in Aotearoa New Zealand. At least seven literature reviews of CBM (Royal *et al.* 1998; Harmsworth & Tipa 2006; Jollands & Harmsworth 2007; Kennedy & Jefferies 2009a; Nelson & Tipa 2012; Awatere & Harmsworth 2014; Harmsworth, Awatere & Robb 2016) and 18 case studies (IKHMG 2010; Environs Holdings Ltd 2011; Harmsworth & Awatere 2013) have been undertaken. Monitoring is a fundamental aspect of *kaitiakitanga* (Ministry for the Environment & Otaraua Hapū 2003) where kaitiakitanga refers to the management of natural resources and long-term interrelationships between people and place. Kaitiakitanga is a holistic and connected perspective. Kaitiaki – or the characters who practice kaitiakitanga – operate at, at least three levels these being the spiritual guardians, *manawhenua* tribes, and individuals within tribes that maintain those interrelationships. Kaitiaki have obligations, roles and rights to manage resources wisely. The Resource Management Act 1991 asserts the principles of the Treaty of Waitangi and introduced the concept of kaitiakitanga to the general public (NZ Parliament 1991).

In the late 1990s there were calls for Māori to be actively involved in monitoring of the natural environment (Parliamentary Commissioner for the Environment 1998). Culturally-based monitoring tools then started to be developed to help improve cross-cultural understanding and increase Māori participation in natural resource management (Chetham *et al.* 2011). Projects have invariably involved Māori groups in collaboration with Western scientists (e.g. Harmsworth 2002a; Tipa & Teirney 2003; Lyver *et al.* 2017). Despite this, Māori have struggled to have their voices heard

(Jollands & Harmsworth 2007; Awatere *et al.* 2013). Conversely those in authority have also had difficulty hearing the voices of the Indigene. In a recent move, the Environmental Reporting Act, 2015 requires information being gathered to include a Māori perspective. There are an increasing number of reasons why Māori organisations are carrying out or wanting to carry out environmental monitoring projects and programmes. These include:

- As statements of mana[36] and rangatiratanga, and provide a Māori Indigenous voice to the management of Aotearoa New Zealand's natural resources,

- To assist the practice of kaitiakitanga, undertake environmental monitoring and assessments, report on changes in environmental and cultural health, and effect change.

- To assist in the provision of knowledge and information about cultural values in a way which is comprehensible to those in authority and to wider society

- To assist tribes undertake monitoring programmes for their own cultural, educational and economic aspirations and goals,

In response, frameworks, indicators and monitoring methods have been developed that are steeped in Māori values. Some have strong linkages to Western science, others less so. A stocktake of Māori cultural environmental monitoring was carried out as part of a wānanga[37] held in Wellington, in May 2010 (Chetham *et al.* 2010; Chetham *et al.* 2011). Fifty-six projects were identified by participants. Many of these used Western scientific tools, however, seventeen projects utilised fully-functioning CBM field tools, either on their own or in combination with scientific or citizen science monitoring techniques (Chetham *et al.* 2010; Chetham *et al.* 2011). These include the *Stream Health Monitoring and Assessment Kit* (SHMAK), *forest monitoring and Assessment Kit* (FORMAK) (Handford *et al.* 2004) and *the Bush Vitality Assessment* (BVA) kit (Janssen 2004). The majority of CBM projects to date have been in the realm of Tangaroa, such as streams and rivers (Tipa & Teirney 2003; Kaupapa Taiao 2004; Passl & Walker 2005; Harmsworth *et al.* 2011), wetlands, (Harmsworth 1999) marine (Ministry for the Environment & Otaraua Hapū 2003; Wakefield & Walker 2005; Wakefield *et al.* 2007), estuarine ecosystems (Pauling *et al.* 2007; Walker 2009), and lakes (Te Rūnanga o Ngāi Tahu 2005; Pauling & Arnold 2008). Others have developed frameworks and tools to cover multiple or nonspecific domains (Morgan 2004; Kennedy & Jefferies 2007; Jefferies & Kennedy 2009a).

[36] Power, status, charisma
[37] Wānanga ≈ Workshop, forum, discussion

Within terrestrial environments and the domain of Tāne[38], three phases of research has been undertaken in kauri (*Agathis australis*) forests in Northland (Shortland 2011a; Chetham & Shortland 2013; Shortland 2017). The initial project involved interviews and discussion groups with Māori elders and other experts to ascertain kauri forest indicators. Forty-three indicators were identified categorised into four groups: (i) minor vegetation, (ii) trees, (iii) insects and reptiles, and (iv) birds (Shortland 2011b). The next phase involved the identification of a framework to enable the use of cultural indicators in the surveillance and monitoring of kauri dieback (*Phytophthera taxon Agathis*) (Chetham & Shortland 2013). This involved a review of the literature including those by the author (e.g. Walker 2009,2012; Walker *et al.* 2013) as well as a presentation[39] by the author on the Atua framework and methodologies being developed as part of this research to the Tangata Whenua Roopu (TWR) working on the Kauri Dieback Programme. A hybrid Atua – tikanga (values-based) framework was later determined to be the most appropriate by the TWR for their project (Chetham & Shortland 2013). The most recent phase has been a pilot project to further identify a set of culturally-based indicators for kauri forests and an appropriate method for the collection of data. A wānanga was held and an initial prototype assessment method was developed and has been tested at one site (Shortland 2017).

Other recent research within the domain of Tāne has been undertaken identifying themes and developing indicators and metrics for a community-based monitoring system for assessing forest health in the Te Urewera region of the central North Island (Lyver *et al.* 2017). A collaborative research project between the Tūhoe[40] Tuawhenua Trust tribal group and Manaaki Whenua Landcare Research has (i) constructed a Tuawhenua worldview that defines their relationship with the forest; (ii) defined key values and aspirations for their forests; (iii) identified 80+ cultural indicators for monitoring forests; and (iv) applied a mix of scientific and CBM systems to two indigenous forests in different condition (*ibid.*). They advocate the application of both field survey and interview-based indicators as "*likely to be the most effective approach for understanding socio-ecological health and integrity*" (Lyver *et al.* 2017).

CBM tools in New Zealand are invariably driven by a mix of kaupapa Māori and participatory approaches, coupling Western scientific methodologies with customary practices (Chetham *et al.* 2010; Chetham *et al.* 2011; Harmsworth & Awatere 2013; Harmsworth, Awatere & Robb 2016). Typically, selected sites are visited by small teams of expert kaitiaki, often accompanied by family

[38] Tāne also Tāne-mahuta ≈ Deity of the forests and birds
[39] The presentation was made at a mātauranga Māori workshop on the 6th of September, 2013 at Auckland University
[40] Tūhoe also Ngāi Tūhoe ≈ Tribal group of Te Urewera in the eastern North Island

members, with the state of health of a range of pre-determined indicators being scored on a Likert type of scale. Discussions take place and qualitative data are collected in the form of written narratives or digital recordings. Paper forms are usually used with data being later transferred to a data base. Some tools have digital versions, such as *State of the Takiwā* (Pauling & Mattingley 2007) and *Mauri-ometer* (Morgan 2013). Some groups incorporate mapping tools into their methods (Harmsworth *et al.* 2011). The current level of CBM activity in New Zealand today is outlined in Appendix 1 along with their characteristics including frameworks, tohu, metrics and tools where these have been developed.

The characteristics of three key CBM field tools in regular use in New Zealand are briefly outlined next. The most popular tool is the *Cultural Health Index* (CHI) originally developed by Tipa and Teirney (2003) for streams and waterways. Around the same time (Harmsworth 2002a) developed a similar tool – *Māori environmental performance indicators tool for wetlands*. Both tools incorporate Māori and Western ways of knowing into their design. Each has a range of indicators grouped into value-based baskets (i.e. the CHI contains a set of indicators grouped according to (i) traditional association, (ii) mahinga kai[41] and (iii) cultural stream health. The health of each indicator is rated by kaitiaki quantitively on Likert scales along with qualitative comments on field sheets with space for overall comments and recommendations. Variants of the CHI approach have been adapted and developed for other domains, such as estuaries (Walker 2009) and the marine environment (Akins *et al.* 2013).

Tribal groups in Nelson utilise an Atua framework based on six domain Atua[42]: Tangaroa, Tāne Mahuta, Haumietiketike, Tāwhirimātea, Tūmatauenga[43] and Rongomātāne to structure their iwi management plan *Ngā Taonga Tuku Iho ki Whakatū* (Passl 2004) and arrange culturally-based indicators for monitoring of freshwater (Passl & Walker 2005; Harmsworth *et al.* 2011) and estuaries (Walker 2009) (Figure 3). It is currently the only framework identified which is used for CBM purposes, but other Atua frameworks probably have potential to be useful for identifying indicator sets.

[41] Mahinga kai ≈ Food-gathering place or species harvested
[42] 'Domain Atua' are also referred to as 'Departmental Atua'
[43] Tūmatauenga also Tū ≈ Deity of people and war

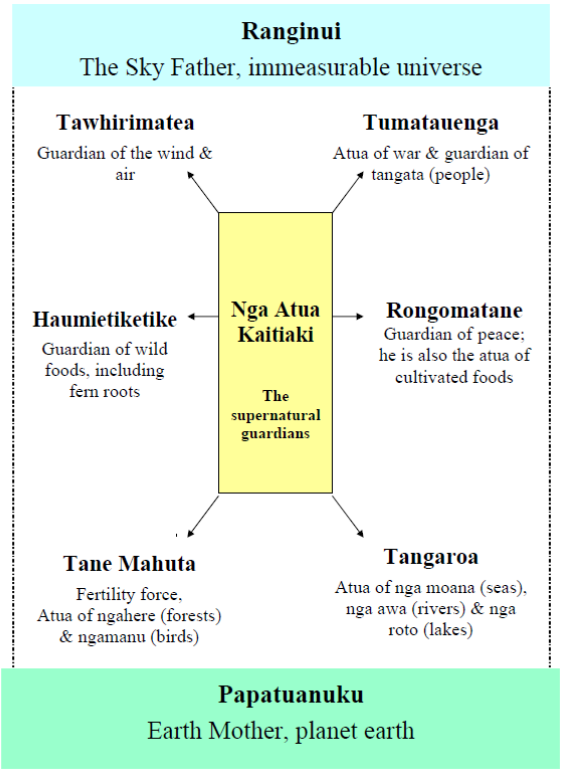


Figure 3: The Atua framework which frames Ngā Taonga Tuku Iho ki Whakatū Management Plan structure (Source: Passl, 2004 (with permission 2012))

Ngāi Tahu in the South Island have developed *State of the Takiwā*. Takiwā is a tool that incorporates CHI and SHMAK assessments. It is used to assist kaitiaki report on a range of systems including freshwater, estuaries and lakes (Pauling 2004; Mattingley & Pauling 2005; Pauling 2007; Pauling *et al.* 2007; Pauling & Arnold 2008). A third digital version (Takiwā 3.0) is under development to improve data input and centrally collate data[44].

The *Mauri Model* (Morgan 2007b) draws on the concept of 'Mauri'. Mauri is a central component of the Māori perspective on the environment. It can be defined as the life principle, the life supporting capacity, or life force present in all things, animate and inanimate. Mauri has been used as a measure of environmental health (Harmsworth 2002a; Morgan 2007b; Ruru 2014; Martin-Paul, Wikaira & Hodgson 2017). Harmsworth (2002a) felt that, if used in the right way, mauri could be used as a generic indicator. He introduced an 'assessment of te mauri' utilising two Likert scales to measure cultural health across 14 indicators for wetland situations. The Mauri-ometer has been developed as a barometer or Mauri-ometer of sustainability (Morgan 2004,2006,2007b,a,2008; Mahi Maioro Professionals 2011). It utilises a weighted -2 to +2 semantic differential scale to assess the health of a range of indicators grouped according to four dimensions: ecosystem, cultural,

[44] https://www.takiwa.org.nz/

community and economic. The use of mauri in such a quantitative way has not gone unquestioned. Mauri embodies both tangible and intangible traits (Marsden & Henare 1992; Kennedy & Jefferies 2009b; Environs Holdings Ltd 2011). Tipa and Teirney (2003) consider mauri, as a metric of cultural values, difficult because intangible traits cannot be encompassed by an index. They felt that it would "*be demeaning to the concept – and to the fundamental beliefs of Māori – to try to devise a mauri index*" (Tipa & Teirney 2003). However, they also realised that mauri is integral to discussions around environmental health.

Most CBM tools developed in New Zealand include a qualitative component where kaitiaki are encouraged to explain reasons behind scores, as well as make general comments or recommendations (Harmsworth 2002a; Tipa & Teirney 2003; Morgan 2007b; Pauling & Mattingley 2007; Walker 2009; Harmsworth *et al.* 2011; Lyver *et al.* 2017). Awatere *et al.* (2013) suggest that Māori are more supportive of qualitative approaches, as these are more consistent with expressing Māori values and knowledge.

2.5 Barriers and bridges

Despite international recognition of the rights of Indigenous People and the value of Indigenous ways of managing biodiversity and natural resources (UNEP 1992a,b; The Montréal Process Working Group 2015a,b) the participation of Indigenous Peoples in NRM continues to present challenges (Danielsen *et al.* 2009; Raymond *et al.* 2010; Awatere *et al.* 2013; Tengö *et al.* 2017). Danielsen *et al.* (2009) found that while CBM frequently includes the extensive involvement of local people, it is the local people who bear much of, if not all, the cost. However, the benefits of Indigenous Peoples' participation in CBM potentially accrue to wider society. Jollands and Harmsworth (2007) found that the level of participation of Māori in sustainability monitoring remains low, under-resourced, and uncoordinated. Chetham *et al.* (2010) described the situation as of concern.

Power structures, cross-cultural communication and conceptual differences have been identified in New Zealand as barriers to Māori participation in NRM. Inherent power differentials privilege the science of the 'West' and continue the colonisation project (Smith 2012). There is growing awareness that those involved in defining the indicators control what is measured and reported (Jollands & Harmsworth 2007). Political will may be elevated at the international level but within countries the participation of Indigenous People varies, depending on the willingness of authorities to listen to Indigenous voices, understand and effectively engage (Awatere *et al.* 2013). Conflict with political authorities and industry agendas continue to restrict the participation of Indigenous peoples' involvement in mainstream NRM (Awatere *et al.* 2013).

Communication is both a barrier and a bridge to increased participation by Indigenous peoples in NRM in general and CBM in particular. Language, cultural and communication differences between Western scientists and local communities need to be reconciled (Hambly & Angura 1996). Metge and Kinloch (1978) refer to the lack of understanding between Māori and Pākehā as two cultures "talking past each other". "*Problems are compounded when the communication is between the language and thought processes of an indigenous people on the one hand and a 'Western' influenced culture of a colonising people on the other hand*" (Williams 1997). Under such scenarios Indigenous peoples struggle to present, or struggle to have opportunities to present, their values in ways which are comprehensible to government agencies, decision makers and mainstream society (Harmsworth 2005). Conversely, resource management authorities may recognise the value of Indigenous peoples' knowledge and the importance of including the Indigene in decision making, however they may struggle with how to adequately or appropriately involve them (Tipa & Teirney 2003; National Institute of Water and Atmosphere 2010). Chetham *et al.* (2011) point to what they see as a lack of models for the effective engagement of Western science and Māori approaches to monitoring.

When attempting to converge different types of knowledge into NRM the epistemological and ontological gulf between Western and Indigenous Peoples' creation of reality presents challenges (Raymond *et al.* 2010). Eurocentric Western science is based upon individuality, objectivity and empiricism (Adam & Kneeshaw 2008). Indigenous realities are community focused, subjective and can be intangible (Marsden & Henare 1992; Miller 2005). "*Scientists have difficulty understanding knowledge or wisdom that does not measure things in the same way, or in the same language as conventional science, and that requires an understanding of, if not a role in, the local cultural context*" (Hambly & Angura 1996). Scientific frameworks, methods and tools, may have a complexity which is an impediment to their use by Indigenous communities (Saint-Arnaud *et al.* 2009). Bohensky and Maru (2011) report of distrust and fear of diluting scientific rigor in favour of political correctness. Adam and Kneesaw (2008) stress unfamiliarity and lack of comfort among ecologists in using social science methodologies and engaging in cross-cultural interactions. Fear of engagement on the part of Indigenous peoples, through negative experiences of cultural appropriation and distrust is a further barrier (Stevenson 1996; Chilisa 2012; Smith 2012; Awatere *et al.* 2013). 'Fear' is a common theme that maintains the conceptual gap, which can only be broken by the development of relationships and trust. A lack of resources and effective working relationships and "*the persistent European 'blind spot' to what Māori culture can offer*" work to prevent the meaningful inclusion of Māori in mainstream NRM (Higgins 2010).

In some cases, developing CBM tools has been an empowering exercise for Indigenous peoples but implementation of programmes is often a challenge (Saint-Arnaud *et al.* 2009). While Indigenous

groups often want to monitor the health of forests jurisdiction is a problem for them with a lack of legislative authority over natural resources outside the bounds of those resources directly owned by them is a barrier (Ron Trosper, University of Arizona, personal communication, 2011). As has been outlined, support for the research and the development of CBM tools and pilot projects in New Zealand has been forthcoming however, it has been intermittent. Support for long-term monitoring programmes has been fraught with a lack of capacity for Māori groups and apathy amongst monitoring authorities (Chetham *et al.* 2011). The Motueka ICM Programme (2001 – 2011) had some success in building relationships and the capacity of manawhenua Māori in the Motueka - Riwaka catchment due to the duration of the programme. Once the programme ceased so too did the ability of manawhenua to undertake long-term monitoring in the catchment. However, freshwater monitoring tools developed through the programme continue to be used for monitoring resource consent applications where the development affects cultural values associated with rivers and streams (Daren Horne, Iwi Liaison Officer, Tiakina te Taiao, May 2017, personal communication).

2.6 Summary of literature review

Collaborative research and participatory monitoring is widespread around the globe, however most contemporary monitoring by Indigenous people operates on Western scientific premises. Culturally-based monitoring is a participatory approach particular to Indigenous peoples. CBM provides a platform for cross-cultural communication, creating opportunities for the weaving together of different but complementary approaches. CBM offers an empowering way forward for Indigenous peoples. CBM is led by Indigenous groups undertaking monitoring from their own perspective. It operates in the Indigenous – Western border space encompassing collaborative, complementary, decolonising and 'bottom-up' approaches. In CBM Indigenous people have control or share the control of projects and programmes. They are instrumental in the process and design of indicators, frameworks and methods. Data is collected, interpreted and analysed by them through their own ways of knowing, and with care can draw upon Western science and methodologies to maximise the strengths of both approaches. Aotearoa New Zealand is a hotspot of CBM activity. The concept is well-known and Māori groups are familiar with its practice so this makes it an ideal location for a case study approach to further understanding the benefits and challenges of CBM.

Indicators, frameworks, and methods are three main components of the theory and practice of CBM. To improve the utility, robustness and practicality of CBM tools it is contended that all these aspects need to be explicitly considered in the design of tools. Tool development and short-term projects in Aotearoa New Zealand have attracted funding, support and capacity development over the last twenty years however, long-term monitoring programmes are few and far between. It is contented

that the development of well-designed and proven tools should attract better support and financial resources for long-term programmes.

Key findings of this literature review which help provide a sound rationale for this research are summarised below.

1. Māori have an important contribution to make to biodiversity and resource management, including the sustainable management of indigenous forests,

2. The strengths of Indigenous ways of knowing include holism, interconnectedness, and being based on a long-term intergenerational timeframe,

3. While there are national and international examples of forest monitoring projects and programmes being carried out by Indigenous people, they invariably use citizen science-based or community-based tools framed on Western premises,

4. There is a lack of formal tools for gathering information on cultural values in relation to both biodiversity and indigenous forests,

5. Frameworks and tools are for the monitoring of biodiversity, including indigenous forests, from a Western perspective are well-developed and in current use in Aotearoa New Zealand. A variety of monitoring programmes are in place at the national and regional level,

6. Culturally-based monitoring tools for monitoring the domain of Tangaroa have been developed and are currently in use in Aotearoa New Zealand. Monitoring programmes are sporadically supported,

7. Aotearoa New Zealand has international and national obligations to monitor biodiversity, including indigenous forests, from kaupapa Māori perspectives. Some research projects have identified tohu for forests however, field tools have not been developed, and therefore monitoring programmes are not in place and these obligations are not being met,

8. A framework and process based on a Māori epistemology will be appropriate for identifying and arranging a set of tohu for indigenous forests,

9. A convergence of Indigenous methods of inquiry with empirical approaches of Western science can together provide a wider understanding of forest health and therefore forest management,

10. Barriers continue to block the participation of Indigenous Peoples in NRM. Power, cross-cultural communication and conceptual gulfs need to be addressed to make progress in opening pathways for participation.

It is contended that through the identification of tohu and the development of well-designed and tested tools progress can be made. If CBM tools have proven utility both from social justice and biodiversity management perspectives, then they have a greater chance of being accepted by those in authority and attracting support for short- and long-term monitoring programmes. With these programmes in place then Aotearoa New Zealand has clearer pathways to meeting its international and national obligations to monitor the state of indigenous forests from Indigenous perspectives.

In the next chapter the theoretical framework behind the development of a CBM approach in a New Zealand case study is outlined, including the process behind the development of a conceptual framework, a set of tohu and an assessment tool. This theoretical framework is underpinned by kaupapa Māori and action research methodologies.

Chapter 3

Theoretical Framework

"Theory – the seeing of patterns, showing the forest as well as the trees – theory can be a dew that rises from the earth and collects in the rain cloud and returns to the earth over and over. But if it doesn't smell of the earth, it isn't good for the earth"

Rich (1984).

3.1 Introduction

For the researcher the purpose of theory is to provide a pathway through a cognitive landscape in search of practical solutions to real world problems. Some pathways are well-worn; the theory is established, and the methodology and methods are suitably charted. If the researcher follows such a path, they simply apply the theory and methodology, and armed with appropriate methods they eventually reach their destination by placing one foot in front of the other. For other research projects the way is unmapped, the path is indistinct or broken – even risky. The researcher may be led down the wrong path only then to have to retrace their footsteps. There may be places where the path is clear and has relevance to their journey and other places where they have to rock-hop, or bush-bash and create their own track. Depending on who they talk to, what they observe in the field or find out along the way, the destination may change. This new-found knowledge may even point to a new, more preferable end state, a place not envisaged at the outset. The researcher may even create their own theory or methodology (e.g. Lewin 1946; Freire 1982; Smith 2012).

Undertaking collaborative research with Indigenous peoples presents unique challenges for Western scientists. In *Decolonizing Methodologies,* Linda Tuhiwai Smith describes two knowledge systems – one of the academic and informed by Western knowledge and systems, rules and values. She refers to it as the science of 'the West'. This knowledge system is underpinned by a belief in positivism, empiricism and objectivity. Its ideology is hidden by its own construction of reality. "*Understanding is viewed as being akin to measuring. As the ways we try to understand the world are reduced to issues of measurement, the focus of understanding becomes more concerned with procedural problems*" (Smith, 2012, p. 44). The Eurocentric Western knowledge system goes beyond the boundaries of science, encompassing Western philosophy, religion and the whole of its belief system (*ibid.*). Indigenous academic Bagele Chilisa (2012) contends that current research traditions are founded on this belief system. The culture, history and philosophy of the Western academy controls "*the power*

to label, name, condemn, describe or prescribe solutions to challenges in former colonized, indigenous peoples and historically oppressed groups" (Chilisa, 2012, p.1). Other critical theorists have expressed misgivings about the role of science as the dominant creator of knowledge and its hold onto power. They claim that objectivity, rationality and suppression of emotionality (collectively 'positivism') are highly valorised in science (Plumwood 1993). Subjectivity, intuition and emotion are conversely attached to negative associations (Mellor 1992; Plumwood 1993). Critics have argued that science often fails to recognise the myriad of local truths, is based on hidden and often flawed assumptions and that these assumptions are self-serving. Some have argued that the epistemological positions of the Indigenous and the West are incommensurable – like trying to mix oil and water – and have demanded that the research community stay out of research with Indigenous Peoples (Chilisa 2012; Smith 2012; Cram 2016). Indigenous – Scientific approaches have been challenged as expressions of colonisation and a continuation of the hold on power by the non-Indigenous. Williams (1997) questions what he refers to as the 'assimilationist' approach whereby the merit and validity of mātauranga Māori lies only in the extent to which it can be validated and utilised by mainstream science. The notion of *"'integration' remains problematic, invoking past power imbalances and assimilation of Indigenous Knowledge by science such that the distinct identities of Indigenous Knowledges are no longer recognizable*" (Bohensky & Maru 2011). Chilisa, however, cautions against wholesale rejection of Western research paradigms simply because they originate in the West or the easy acceptance of what she calls "*potentially ill-judged ideas just because they were developed from an indigenous community*" (Chilisa 2012). Research from the positivistic tradition has made great gains in technology, medicine and other areas to improve the wellbeing of humankind.

Collaborative and participatory research approaches are having some success in bridging the gap between Western and Indigenous methodologies (Kahakalau 2004; Chilisa 2012). A meeting of the minds is possible if research proceeds with caution and trust (Marsden 1992; Wong 2006). New postcolonial Indigenous epistemologies and methodologies are required in order to make progress (Chilisa 2012; Smith 2012). Power relationships need to be discussed, challenged and addressed from the outset and appropriate Indigenous research methodologies, processes and strategies utilised. Chilisa (2012) encourages the researcher to "*conduct research without perpetuating self-serving Western research paradigms that construct Western ways of knowing as superior to the Other's way of knowing*". Smith (2012) argues that the process of "decolonisation" is a necessary part of Indigenous Peoples' revitalisation and development, and she encourages Indigenous People to embrace the challenge. This includes exposing the dominant positivist ideologies and power

structures of the 'West', challenging the Western worldview as the norm and traditional Indigenous worldviews as 'the Other'.

Natural alignments between Indigenous ways of knowing, and theory and methodologies from the Western academy have been identified. Harmsworth *et al.* (2011) refer to 'complementary' approaches and 'linkages' between traditional and Western philosophies as pathways forward in collaborative research. Johnson *et al.* (2016) refers to 'intersections' between Indigenous and sustainability sciences, with the knowledge generated being described as 'hybrid' knowledge (Raymond *et al.* 2010). Others describe 'integrating', 'combining' or 'weaving' Indigenous and Western knowledge systems together as more power-balanced descriptors of participatory Indigenous – Western science approaches to NRM (Moller *et al.* 2004; Johnson *et al.* 2016; Whyte, Brewer & Johnson 2016; Tengö *et al.* 2017). Macfarlane, Macfarlane and Gillon (2015) advocate a 'braided rivers' approach in bringing the two knowledge streams together to blend and interact.

A convergent Indigenous – Western science methodology has been sought to underpin this research. This research sits within an Aotearoa New Zealand cultural context, so it is imperative that at its foundation it is kaupapa Māori, that is, it is theoretically informed by appropriate kaupapa Māori theory and methodology and it is kaupapa Māori in practice. The approach does not reject the science of 'the West' but it is acutely aware of its colonising tendencies (after Smith 2012). Following an outline of the assumptions that helped to frame the development of a convergent Indigenous – Western methodology the concept of kaupapa Māori is described, along six 'intervention' principles by Smith (1990) and one each from Pihama (2001) and Pohatu (2005).

Action research has been identified as an appropriate convergent theory, from the family of participatory, emancipatory, collaborative and power-balanced approaches, that aligns well with Indigenous values and can lead to more robust outcomes (Kahakalau 2004). O'Reilly (2010) calls kaupapa Māori and action research "a neat fit". Action research has a natural synergy with, and can support and help implement, a kaupapa Māori approach (Moller *et al.* 2009; O'Reilly 2010; Cram 2011) so it made good sense to bring these together in this research. Action research is counter-cultural (after Dick 1993) as is kaupapa Māori. They both challenge the positivistic construction of reality and offer overtly subjective ways forward. Action research and kaupapa Māori are strongly contextual. They both emphasise a reality where the research journey (the process) is as important to the research as is the destination (the output).

In this chapter eight key principles of kaupapa Māori are first outlined, followed by six core themes of action research, which underpin the theoretical framework of this research. How these principles

and themes were embodied in the research practice are touched upon. Methodologies for evaluating the trustworthiness and rigour of collaborative research projects from both kaupapa Māori and Western perspectives were investigated to form a convergent evaluation methodology outlined in Section 3.5. An evaluation of our research practice is undertaken in Chapter 5, Section 5.7 using evaluation criteria from both perspectives. This evaluation further elucidates how kaupapa Māori research and action research are embodied in this research.

3.3 Kaupapa Māori research

Kaupapa Māori is an ancient phenomena embedded in the cultural being of Māori (Pihama 2001; Mahuika 2008). It is a growing and evolving approach to undertaking Indigenous research in New Zealand. In many ways it defies classification, elucidating levels of understanding through philosophy, theory, methodology and praxis. Charles Mohi describes mātauranga Māori as "*the knowledge, comprehension, or understanding of everything visible and invisible existing in the universe*" (Mohi in Williams 1997). Kaupapa Māori is a critical response against the dominant Western power base and positivist worldview (Pihama, Cram & Walker 2002; Smith 2012). "*Kaupapa Māori theory aligns itself with critical theory in that it seeks to expose power relations that perpetuate the continued oppression of Māori people*" (Pihama, Cram & Walker 2002). Kaupapa Māori has been described as "*an approach based on Māori philosophy and guiding principles*" (Wong 2006). Its methodologies are emancipatory and provide paths of self-determination for Māori. Kaupapa Māori is both informed and held together through mātauranga Māori knowledge and is expressed in practice through tikanga customs (Kennedy & Jefferies 2007). Under kaupapa Māori the historical connections of Indigenous communities to place must be acknowledged, research should be based on the traditional Indigenous knowledge and be driven by the needs of 'the researched', as defined by themselves (Pihama 2001; Cram 2011; Smith 2012). As a research methodology kaupapa Māori is well developed in the areas of education, cultural identity and gender issues.

Kaupapa Māori is inherently counter-hegemonic and shares approaches with international counter-hegemonic theories, methodologies and praxes – those that challenge the positivistic construction of reality promulgated by modern Western science, those that act as tools of resistance and emancipation, and those that undertake transformative action (Morrison 1999). A diverse spectrum of Indigenous epistemologies and research methodologies have been developed and applied to redress political imbalances (Chilisa 2012). Timothy Church and Marcia Katigbak refer to an Indigenous – science model. At one end of the spectrum they refer to an *encounter stage* which "*acknowledges the limitation of applying Western theories, categories of analysis, findings, and modes of reporting, and (researchers) attempt to address the challenge through a limited degree of*

adaption of these imported concepts, models and measures with the hope of gaining better understanding of local circumstances" (Church & Katigbak in Chilisa 2012). At the other end of the spectrum they identify an *immersion-emersion* stage where Western research paradigms are rejected in favour of post-colonial Indigenous research epistemologies and methodologies. Māori resource management models and tools are similarly positioned across a spectrum. Some have their basis in Western science but are indigenised to give them greater cultural relevance. Other models claim to reject the science of the West but, while they have their roots in kaupapa Māori, they often draw upon Western scientific methodologies and methods to increase their acceptance and effectiveness (Pihama, Cram & Walker 2002). Bishop and Glynn (1999) assert that kaupapa Māori research needs to:

> *"be conducted in culturally appropriate ways – ways that fit Māori cultural preferences, practices and aspirations in order to develop and acknowledge existing culturally appropriate approaches in the method, practice and organisation of research. Kaupapa Māori Research also emphasises the need for researchers to devolve power and control in the research exercise in order to promote self-determination (tino Rangatiratanga) of Māori people".*

Smith (1990) identified six intervention principles of kaupapa Māori. These have influenced the success of Te Kōhanga Reo[45] and Kura Kaupapa Māori[46] educational programmes. Others, including Pihama (2001) and Pohatu (2005) have expanded upon his work and added to these key principles bringing the current number to eight[47]. These principles are:

1. Tino rangatiratanga – The principle of self-determination,
2. Taonga tuku iho – The cultural aspirations principle,
3. Ako Māori – The culturally preferred pedagogy principle,
4. Kia piki ake i ngā raruraru o te kainga – The socioeconomic mediation principle,
5. Whānau – The extended family principle,
6. Kaupapa – The collective philosophy principle,
7. Te Tiriti o Waitangi – The Principle of the Treaty of Waitangi, and

[45] Kōhanga Reo ≈ Māori preschool language immersion. Literally 'language nest'
[46] Kura kaupapa Māori language immersion schools
[47] http://www.rangahau.co.nz/research-idea/27/#smith

8. Āta - The Principle of Growing Respectful Relationships.

These principles underpin much of the work of those who engage in kaupapa Māori research including this research project. Each principle is outlined below.

3.3.1 Tino rangatiratanga – The principle of self-determination

> *"Tino Rangatiratanga relates to sovereignty, autonomy, control, self-determination and independence. The notion of Tino Rangatiratanga asserts and reinforces the goal of Kaupapa Māori initiatives: allowing Māori to control their own culture, aspirations and destiny."*(Rangahau 2014)

Under the principle of tino rangatiratanga or self-determination, kaupapa Māori "*challenges the locus of power and control over the research issues of initiation, benefits, representation, legitimation and accountability*" (Bishop 1999). Māori have legitimate concerns over who controls and benefits from the research being undertaken. Bishop and Glynn (1999) contend that traditionally the primary benefit of research accrues to the researcher and Māori have often been secondary benefactors at best. The research partners in this research view the developed Ketewhaihua as a way to improve their practice of kaitiakitanga of indigenous forests and better fulfil their role as kaitiaki.

3.3.2 Taonga tuku iho – The cultural aspirations principle

> *"This principle asserts the centrality and legitimacy of Te Reo Māori, Tikanga and Mātauranga Māori. Within a Kaupapa Māori paradigm, these Māori ways of knowing, doing and understanding the world are considered valid in their own right. In acknowledging their validity and relevance it also allows spiritual and cultural awareness and other considerations to be taken into account"* (Rangahau 2014).

Taonga tuku iho can be translated as the treasures that have been passed down by the ancestors from one generation to the next. The aspirations of Māori to manage taonga tuku iho (including indigenous forests) and practice kaitiakitanga is paramount. The rights, roles and responsibilities of tangata whenua as kaitiaki[48] are increasingly being recognised and legitimised in legislation, policy and the public space. A primary driver in the management of natural resources has been the introduction of the Resource Management Act in 1991, particularly sections 6(e), 7(a) and 8 which relate to tangata whenua inclusion in the consultation and decision-making process. The draft National Policy Statement (NPS) for Indigenous Biodiversity not only acknowledges Te Tiriti o Waitangi and provided a key role for Māori in its development, but also "*presents a unique opportunity to begin to transition Aotearoa New Zealand's environmental management system to*

[48] Kaitiaki operate at three levels; as traditional deities, as the tribe with rights, roles and responsibilities and, as individuals mandated by their tribe who are an expert in their field

one in which te ao Māori, mātauranga, and tikanga Māori, sit on an even footing with western environmental management as the system's philosophical underpinning" (Biodiversity Collaborative Group 2018). Incorporating Māori perspectives, values and knowledge into the planning process is increasingly considered best practice, however, it is not always a straight forward process for authorities to receive and include the Indigenous voice. Māori groups may have trouble in identifying their own cultural values because of the innate nature of these values or presenting these values and knowledge in forms which are coherent to decision makers. A co-created Ketewhaihua is seen by the research partners as an appropriate way of presenting their cultural values in relation to indigenous forests both to their own people as well others who seek this information.

3.3.3 Ako Māori – The culturally preferred pedagogy principle

> *This principle acknowledges teaching and learning practices that are inherent and unique to Māori, as well as practices that may not be traditionally derived but are preferred by Māori* (Rangahau 2014).

Pihama *et al.* (2004) reviewed the literature on kaupapa Māori and Māori education pedagogy. They refer to the seminal work by Rangimārie Rose Pere (1994) on the ako Māori model. They acknowledge that defining ako is difficult because of the contextual nature of the concept, however, they elicit some features of traditional and preferred ways of learning. Preferred ways of learning may not necessarily be traditional, but they are deemed to be culturally appropriate. In traditional Māori society the creation and transfer of knowledge was primarily to benefit the collective. Education was inclusive, co-operative, reciprocal and obligatory (Pihama *et al.* 2004). Such elements lend themselves to participatory and collaborative forms of research including this research. In brief, the characteristics of traditional ako Māori (from Pere 1994; Pere 1997; Pihama *et al.* 2004) are:

1. A focus on whakapapa links through ancestors, whānau, hapū[49], iwi, mountains, rivers, lakes and the sea.

2. Informal ways of learning involving several generations including grandparents, parents and grandchildren in the one learning environment, and conducted through a range of learner-

[49] Hapū ≈ Kinship group, subtribe. Also means pregnant.

teacher relationships such as tuākana[50] – teina[51] (elder brother or sister – younger relative) and tīpuna whāea[52]/tīpuna mātua[53]– mokopuna[54] (grandparent – grandchild).

3. Where the teaching environment was formal, knowledge was generally passed on through whare wānanga[55] with men and women learning separately,
4. Education was intertwined with the metaphysical – religion and ritual,
5. Knowledge was considered tapu[56] and sanctions were put in place that ensured it was protected, used appropriately and transmitted with accuracy,
6. Chosen members of the whānau were sometimes selected as kaitiaki to be guardians of particular forms of knowledge.

Joan Metge describes Māori teaching as "informal, semi-continuous, embedded in the ongoing life of the community, open and inclusive" (in Pihama *et al.* 2004). The co-creation of the Ketewhaihua embodied Metge's description of the learning process. The Ketewhaihua was designed as a monitoring tool but quickly proved to also be a learning tool. The structure of the group was non-hierarchical, with the co-researchers often speaking of "wearing many hats", sometimes the teacher, sometimes the learner.

3.3.4 Kia piki ake i ngā raruraru o te kainga – The socioeconomic mediation principle

> *This principle asserts the need to mediate and assist in the alleviation of negative pressures and disadvantages experienced by Māori communities. This principle asserts a need for Kaupapa Māori research to be of positive benefit to Māori communities. It also acknowledges the relevance and success that Māori derived initiatives have as intervention systems for addressing socio-economic issues that currently exist* (Rangahau 2014).

There is a need to be cognisant of the issue of socioeconomic disadvantage and how outcomes of research could create positive impacts for Māori. While widespread support for iwi engagement in mainstream resource management may be problematic, the development of culturally-based tools (e.g. the Freshwater Cultural Health Index (Tipa & Teirney 2003) and State of the Takiwā (Pauling *et al.* 2007)) have enhanced the ability of iwi to be involved and effective in natural resource

[50] Tuākana ≈ Elder brother or sister, senior relative
[51] Teina ≈ Younger relative
[52] Tīpuna whāea ≈ Grandmother
[53] Tīpuna matua ≈ Grandfather
[54] Mokopuna ≈ Grandchild, grandchildren
[55] Whare wānanga ≈ Place of higher learning
[56] Tapu ≈ Sacred, prohibited, restricted

management, including environmental monitoring and informing the development of cultural impact assessments. The development of the Ketewhaihua was seen by the research partners as another tool in their kaitiakitanga toolbox.

3.3.5 Whānau – The extended family principle

> *The principle of Whānau sits at the core of Kaupapa Māori. It acknowledges the relationships that Māori have to one another and to the world around them. Whānau, and the process of whakawhanaungatanga are key elements of Māori society and culture. This principle acknowledges the responsibility and obligations of the researcher to nurture and care for these relationships and also the intrinsic connection between the researcher, the researched and the research* (Rangahau 2014).

Whanaungatanga refers to relationships or bonds of kinship. Whakawhanaungatanga is the process of creating and maintaining these relationships. Whanaungatanga emphasizes the role and responsibility of the individual as part of a collective. It gives people a sense of belonging, togetherness, and relatedness. In the traditional Māori worldview relationships were all important, including relationships between people and the physical and spiritual worlds. Whanaungatanga remains a strong part of modern Māori society and continues to shape the relationships between Māori people and the environment (Bishop 1996; Walker, Bunt & Stephens 2003). In a meta-analysis of five research projects carried out by Māori and non-Māori, whanaungatanga emerged as a powerful kaupapa Māori research strategy (Bishop 1996; Bishop & Glynn 1999). They found whakawhanaungatanga to embody three interconnected elements:

1. *Establishing and maintain whānau relationships*. Establishing and maintaining relationships is a fundamental, often extensive and ongoing part of the research process.

2. *Participant-driven approaches*. Establishing relationships in a Māori context helps to address the power and control issues fundamental to research as it involves participatory research practices.

3. *Researcher involvement as a lived experience*. Researchers understand themselves to be involved *somatically* in the research process; that is involved physically, ethically, morally and spiritually and not just as a 'researcher' concerned with methodology (Bishop & Glynn 1999).

Whakawhanaungatanga was an important aspect of the research journey for the research partners. It provided multiple opportunities to reconnect kinship bonds and share knowledge, not only

amongst the core research team. Other whanau members were included in the research journey whenever opportunities arose whether in the field or at hui.

3.3.6 Kaupapa – The collective philosophy principle

> *The 'Kaupapa' refers to the collective vision, aspiration and purpose of Māori communities. Larger than the topic of the research alone, the Kaupapa refers to the aspirations of the community. The research topic or intervention systems therefore are considered to be an incremental and vital contribution to the overall 'Kaupapa'* (Rangahau 2014).

Traditional individualistic research benefits the researcher and their agenda whereas kaupapa Māori approaches favour collective benefits and collaborative and participatory approaches to research. Here the researcher positions themselves in an empowering relationship (Bishop 1999). There is a preference for a long-term development of mutual purpose and intent between the researchers as the collaborators. The relationship between the parties does not end once the research is 'over'. The Ketewhaihua was co-created in a collaborative research context. The relationship between the principle researcher and the co-researchers existed prior to this research and continues to exist outside of the research context and is ongoing.

3.3.7 Te Tiriti o Waitangi – The Principle of the Treaty of Waitangi

> *Pihama (2001) identified another principle to be taken into account within Kaupapa Māori theory: Te Tiriti o Waitangi (1840) is a crucial document which defines the relationship between Māori and the Crown in New Zealand. It affirms both the Tangata whenua status of whānau, hapū and iwi in New Zealand, and their rights of citizenship. The Tiriti therefore provides a basis through which Māori may critically analyse relationships, challenge the status-quo, and affirm Māori rights* (Rangahau 2014).

Under article 2 of the Treaty of Waitangi "*Her majesty the Queen of England confirms and guarantees to the Chiefs and Tribes of New Zealand and to the respective families and individuals thereof the full exclusive and undisturbed possession of their land and Estates, Forests, Fisheries and other properties which they may collectively or individually process so long as it is their wish and desire to retain the same in their possession*…" ('The Treaty of Waitangi' 1840, art. 2).

Despite the guarantees made in the Treaty of Waitangi/ Te Tiriti o Waitangi[57] Māori have been gradually dispossessed of many of these natural resources that they were promised in perpetuity. Today most iwi hold only a miniscule of their former territories and natural resources. They still,

[57] The Māori version of The Treaty of Waitangi

however, retain their kaitiaki roles and responsibilities over these lands and resources. Increasingly intellectual and property rights of Māori to natural resources are being recognised and re-established through policy, legislation and Treaty of Waitangi settlements.

Russell Bishop argues that there is an obligation on non-Indigenous researchers, as Treaty partners, to support Māori research, and those that have desire to support Māori research can be useful allies and colleagues (in Smith 2012). Hudson and Russell (2009) highlight concerns by many Indigenous Peoples involved in research including the "*respect for their indigenous rights, control over research processes and reciprocity within research relationships to ensure that equitable benefits are realised within indigenous groups*", and in Aotearoa New Zealand the importance of the principles of the Treaty of Waitangi for researchers engaging with Māori communities, in particular the principles of partnership, participation and protection.

3.3.8 Āta - The Principle of Growing Respectful Relationships

> *The principle of āta, was developed by Pohatu (2005) primarily as a transformative approach within the area of social services. The principle of āta relates specifically to the building and nurturing of relationships. It acts as a guide to the understanding of relationships and wellbeing when engaging with Māori (Rangahau 2014).*

Āta indicates care, deliberation or thoroughness in carrying out an activity (Moorfield 2011). *"Āta is considered a vital cultural tool created to shape and guide understandings of relationships and well-being. The endeavour to gain meaningful insights into the integrity of āta and its applications has led to the constructing of its following constituents*.

1. *Āta focuses on our relationships, negotiating boundaries, working to create and hold safe space with corresponding behaviours.*
2. *Āta gently reminds people of how to behave when engaging in relationships with people, kaupapa and environments.*
3. *Āta intensifies peoples' perceptions in the following areas.*
    - *It accords quality space of time (wā) and place (wāhi).*
    - *It demands effort and energy of participants.*
    - *It conveys the notion of reciprocity,*
    - *It conveys the requirement of reflection, the prerequisite to critical analysis.*
    - *It conveys the requirement of discipline*
    - *It ensures that the transformation process is an integral part of relationships*

4. *Āta incorporates the notion of planning*

5. *Āta incorporates the notion of strategising"* (Pohatu 2005)

While the Whānau principle acknowledges the relationship that Māori have to one another and the world around them the Āta principle refers to developing enduring relationships between Māori and others. Developing and maintaining such relationships with Māori tribes can be very fulfilling. It can also be frustrating due to competing timeframes, political and personal tensions, and tribal nuances. Each iwi has their own way of doing things in their own timeframe. This is problematic when multiple iwi are involved in the project. However, one has to respect these differences and uphold the mana of each iwi. To carry out this work ethically the researcher should ideally be part of or immersed into the culture one is working within.

In the first edition of her classic volume on research and Indigenous people, *Decolonizing Methodologies*, Linda Tuhiwai Smith stated that "*In the New Zealand context research ethics for Māori communities extend far beyond issues of individual consent and confidentiality*" (Smith 1999). She identified seven relevant whakataukī[58] as ethical codes of conduct for Māori research. These have since been expanded upon by Fiona Cram (Cram 2001,2009) as a "Community-up" approach and act as general guidelines for ethical research for Māori researchers (*Table 1: "Community-Up" approach to defining research conduct*).

Table 1: "Community-up" approach to defining research conduct

Cultural Values (L. T. Smith, 1999)	**Researcher Guidelines** (Cram, 2001)
Aroha ki te tangata	A respect for people—allow people to define their own space and meet on their own terms
He kanohi kitea	It is important to meet people face-to-face, and to also be a face that is known to and seen within a community
Titiro, whakarongo … kōrero	Looking and listening (and then maybe speaking)—develop understanding to find a place from which to speak
Manaaki ki te tangata	Sharing, hosting, being generous
Kia tupato	Be cautious—be politically astute, culturally safe, and reflective about insider/outsider status
Kaua e takahia te mana o te tangata	Do not trample on the "mana" or dignity of a person
Kia mahaki	Be humble—do not flaunt your knowledge; find ways of sharing it

Source: Cram 2009, Table 20.2, p. 314

[58] Whakataukī ≈ unattributed saying or proverb

The Āta principle provides guidance for researchers, including the principal researcher in this research, on the need to build sound relationships while the work of Smith (1999) and Cram (2009) provides guidance on how to act while building those relationships.

3.4 Action Research

> *"Be soft in your practice. Think of the method as a fine silvery stream, not a raging waterfall. Follow the stream, have faith in its course. It will go its own way, meandering here, trickling there. It will find the grooves, the cracks, the crevices. Just follow it. Never let it out of your sight. It will take you"*
>
> Sheng-yen quoted by Moore (2002)

Action research has been referred to as "*an inductive research methodology involving an iterative and cyclical process of action and critical reflection on action*" (Jacobson 2007). As the term suggests, action research refers to dual roles of action and research. *Action* in this context means the act of bringing about positive change. *Research* refers to an increase in understanding on the part of the wider community. The seminal work of Kurt Lewin (1946) along with research at the Tavistock Institute contributed to the early development of action research (Rapoport 1970). "*Action research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable framework*" (Rapoport 1970). Action researchers are concerned with when, where and by whom social research should be done.

Action research actually comprises an eclectic family of research methodologies (Kemmis & McTaggart 1988; Allen 2001; Jacobson 2007). These include participatory action research, action science, developmental action research, critical action research, practical action research, collaborative inquiry, emancipatory research, action learning, community-based participatory research and contextual action research amongst others (Kemmis & McTaggart 1988; Dick 1993). Each variant places an emphasis on a specific theme or set of themes of action research. The six core themes of action research identified (from Kemmis & McTaggart 1988; Avison, Baskerville & Myers 2007) are:

1. a cyclic and iterative process
2. collaboration through participation
3. emancipation of participants for social change
4. learning through experience
5. qualitative nature of the research and,
6. the importance of critical reflection.

These themes are concerns shared by Indigenous researchers and resonate with the principles of kaupapa Māori. As such, action research and kaupapa Māori research are further cemented as appropriate partners. The six themes of action research are outlined below.

3.4.1 Cyclical and iterative process

For many research projects the researcher is driven by a clear objective, research question or hypothesis and the methodology is selected or designed on this basis. Action research acknowledges that research is rarely linear and that clear objectives are not necessarily definable from the beginning. This is particularly relevant in collaborative research where research participants are party to or drive the design and planning process. Lewin (1946) advocated a "*spiral of steps each of which is composed of a circle of planning, action, and fact finding about the result of the action*". More recent commentators depict action research in terms of a cyclical or spiral of action research cycles, usually consisting of four phases involving an iterative and cyclical process of planning, acting, observing and reflecting (Kemmis & McTaggart 1988; Allen 2001; Dick 2002; Jacobson 2007).

The unfurling fern or koru was utilised to depict the four phases in this research to increase the cultural relevance of the process (Figure 4).

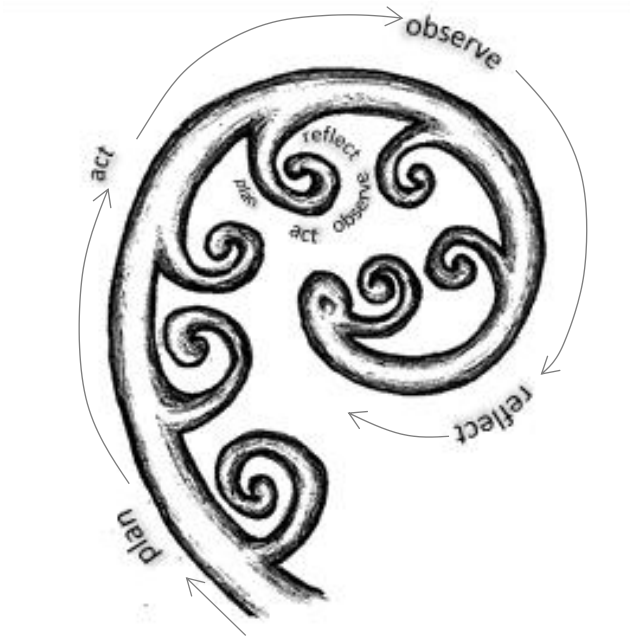


Figure 4: The koru symbolises a set of unfurling action research spirals

The koru is a strong symbol within Māori culture expressed in traditional and contemporary art and design (e.g. whakairo carvings and tā moko tattoo). It is a symbol of creation and conveys the idea of perpetual movement, and its inward coil suggests a return to the point of origin[59]. A research cycle is complete as the collective frond is unfurled. Expanded action research components are (1) develop a **plan** for improvement, (2) **act** upon or implement the plan, (3) **observe** and document the effects of the plan, and (4) **reflect** on the effects of the plan for further planning and informed action (Kemmis & McTaggart 1988). It is typical for each research cycle to take place several times through an iterative process where each new, but different, cycle or spiral builds on the understanding of the previous.

In most forms of conventional research, one collects all the data first and the analysis, interpretation and reporting is then carried out. In action research one collects some data. It is then analysed, and the research question and interpretation is refined through iterative cycles (Dick 1993). To start the process of action research Dick recommends the researcher to "*begin with fuzzy research questions and methodology. This will give fuzzy answers, but through subsequent iterations one can refine both the questions and methodology and eventually converge towards precision. It is the spiral process which allows both responsiveness and rigour at the same time*" (Dick 1993). He asserts that the virtue

[59] Te Ahukaramū Charles Royal. 'Māori creation traditions - Common threads in creation stories', Te Ara - the Encyclopedia of New Zealand, updated 15-Nov-12
URL: http://www.TeAra.govt.nz/en/photograph/2422/the-koru

of action research is its responsiveness. "*It is what allows you to turn unpromising beginnings into effective endings. It is what allows you to improve both action and research outcomes through a process of iteration. As in many numerical procedures, repeated cycles allow you to converge on an appropriate conclusion*" (Dick 1993).

In this research the research cycles involved (1) **Plan –** Undertake regular hui where the method, tohu and metrics are confirmed, modified or rejected, (2) **Action** – Test method, tohu and metrics in the field (3) **Observe** – Document fieldwork and, (4) **Reflect** – Complete feedback forms.

3.4.2 Collaboration through participation

Action research is suited to approaches whereby the research is grounded in the collaborative voices and experiences of the participants – action research is only action research if it is collaborative. Under action research methodologies research is carried out with participants or on behalf of them, rather than on them (Dick 1993). Those that the research will benefit need to be active partners in the project rather than simply passive participants. Participants need to be involved in all stages as co-researchers from setting the agenda of the enquiry, developing the research questions or hypotheses, collecting data and carrying out analysis, controlling of the overall process and outcomes, and implementation of the results (Kemmis & McTaggart 1988; Friend, Dunn & Jennings 2009).

The collaborative and participatory principles of action research parallel those of kaupapa Māori - "*Kaupapa Māori research is collectivistic and is oriented toward benefiting all the research participants and their collectively determined agendas, defining and acknowledging Māori aspirations for research, while developing and implementing Māori theoretical and methodological preference and practices for research*" (Bishop, 2005, p. 114). Kaupapa Māori and other Indigenous research methodologies challenge conventional research on the basis of power differentials between the researcher and the researched (Bishop & Glynn 1999; Pihama *et al.* 2004). Who carries out the research and who benefits from the research are as important questions to the enquiry as to the nature of the research.

3.4.3 Emancipation of participants for social change

> *"The silenced are not just incidental to the curiosity of the researcher but are the masters of inquiry into the underlying causes of events in their world. In this context research becomes a means of moving them beyond silence into a quest to proclaim the world."* (Freire 1982)

Action research is inherently ethical. It is not undertaken simply as 'research for research sake' but focuses on the emancipation of the co-researchers and the group to which they belong. Lewin (1946) stated that "*Effective social change depends on the commitment and understanding of those involved in the change process*". To attain this commitment and understanding co-researchers must be empowered in the research process. The research is not only 'of the people' but also needs to be 'by the people'. Nicholls (2009), Pihama (2001) and Smith (2012) favour approaches that are actively counter-colonial and decolonising for the participants.

Action research methodology lends itself to community development situations. It does not seek to be objective, but rather explicitly subjective. It seeks to liberate those who are party to the research and is overtly committed to creating social change. Action research pursues transformation and empowerment of the research participants which parallels the kaupapa Māori principle of tino rangatiratanga or self-determination. Pihama (2001) and Smith (2012) see the emancipatory intent of kaupapa Māori as part of the decolonising process.

3.4.4 Experiential Learning

"*PAR builds on the critical pedagogy put forward by Paulo Freire (1982) as a response to the traditional formal models of education where the teacher stands at the front of a class and imparts information to the students who are passive recipients*" (Culatta 2011). Action research is popular amongst researchers working in the field of education. It challenges the usual teacher – student relationship where the teacher is viewed as the expert and student is expected to learn from them. Such a "top down" approach is reversed in action research in favour of a "bottom up" approach which places the relationship on a more of an equal footing in terms of power and knowledge. It has been used effectively to improve collaborative learning environments for participants including students, teachers and managers. Its purpose has been to gain a better understanding of education problems, improve learning outcomes, foster change and manage the process of improvement within educational institutions. Inspired by Lewin, David A Kolb and colleagues developed a theory of 'experiential learning' or 'learning through practice' which, like action research, consists of four cyclical steps or stages – (1) concrete experience; (2) reflective observation; (3) abstract conceptualisation and (4) active experimentation (Kolb 1984; Kolb, Boyatzis & Mainemelis 2000). An action research cycle can regarded as a learning cycle (Dick 1993). A learning cycle begins with concrete experience based on previous learnings, and is followed by the other three steps in a sequential and continually iterative cycle (Kolb 1984; Kolb, Boyatzis & Mainemelis 2000). In reality all steps may be occurring at the same time (Jeffs & Smith 2005).

Kolb's theory acknowledges that people naturally have different learning styles and learners learn better when the subject matter is presented in a manner consistent with their preferred style. These learning styles are determined through factors such as cultural or social environment, educational experiences, personality type and adaptive competencies. Diana Laurillard (2012) found that "*learning through practice is different [to other forms of learning such as learning through formal inquiry] because it goes beyond the realm of language and representation. In terms of human evolution, learning from experience long predates learning through language*". Experiential learning provides a good platform for learning in situations where those learning have little experience of formal inquiry, or where there are a mix of learning types and experience, or where there is no discernible teacher, or the teacher – student roles are fluid amongst a group of learners.

There are strong parallels between experiential learning and, ako and āta approaches to learning which embody a reciprocal approach "*where teacher and learner are not clearly distinguishable because of the interchangeability of the roles*" (Wong, 2006, p47). In the research environment such methodological approaches, with ideals of equality and reciprocity, encourage learning to flow freely between co-researchers. As in action research, the koru symbol can also be helpful to visualise and culturally contextualise Kolb's four stages of experiential learning. The koru symbolises growth and the unfurling of achievement in learning through education and pathways in life (Ministry of Education 2013). The learning process in this research was conceived as an unfurling fern frond and each pinna a personal or collective learning spiral.

3.4.5 Qualitative approaches

From the late 1970s qualitative approaches to research began to be seen as better suited to social inquiry than quantitative approaches. Qualitative research increasingly gained favour "*as a more subjective, culture-bound and emancipatory approach to studying individual behaviours and social phenomena, and it introduced innovative new research methods for answering questions*" (Tashakkori & Teddlie 2003). These methods began to be utilised in disciples outside of anthropology and sociology as a general reaction against positivism. "(S)*tudies adopting quantitative methods attempt to obtain a high level of objectivity and detachment, but they nearly completely neglect the issue of meaning: How do participants interpret the situation, and what meanings do they give to actions? The issue of meaning is more directly addressed through qualitative research*" (Wong, 2006, p.122). However, the merits, validity and the rigor of qualitative research procedures did not go unquestioned. The either-or dichotomy between qualitative and quantitative research was set up and often led to entrenched positions. Emmerson and Goodrick (2009) refer to these as 'the paradigm wars'.

The use of qualitative and quantitative methods results in different types of knowledge being generated and therefore are still often seen as rivals. It has been argued that because of their different underlying paradigms they should not be mixed (Barbour in Golafshani 2003). However, advocates of mixed methods and other forms of convergent methodologies argue that they can be complementary (Jick 1979). Mixed methods research emerged as a theoretical and pragmatic base that combines both qualitative and quantitative approaches, but overcomes the limitations and builds on the strengths of each. Action research is dominated by qualitative techniques and while these can give meaning to phenomena, quantitative research can also provide a complementary measurement of attitudes, values or trends. While recognising the positivistic nature of the quantitative tradition, the use of more than one approach can be used to cross-check and enhance confidence in the evaluation of findings – a strategy known as triangulation (Golafshani 2003). In this research the primary approach was qualitative but supported by quantitative data.

3.4.6 Critical reflection

Central to emancipatory and collaborative approaches is the practice of critical reflection or reflexivity. "*Reflection starts with the individual researcher including the values and interests they bring to the research, and their potential influence on the research process*" (Jacobson 2007). Reflexivity recognises that when researchers are working with people (informants or collaborators) in what Brewer (2000) refers to as "naturally occurring settings" they impart the biases of themselves and their scientific discipline upon the research and the results. Action researchers use reflexivity to help question underlying assumptions (Bradbury *et al.* 2017). Action research is a form of self-reflexive inquiry (Kemmis & McTaggart 1988; Fetterman 2015). "*The inquiry … involves a strong element of critical self-reflection or self-education about the researcher's own performance and the unique context in which it occurs*" (Cardno 2003). The kaupapa Māori principle of Āta includes reflection in its practice (Pohatu 2005). It is important for an outsider working in the Indigenous space not only to be reflective about the process – that is to analyse, synthesise, explain and draw conclusions, but also to be self-reflective. The researcher acknowledges the power differentials between the researcher and co-researchers and takes steps to identify and address these.

Reflection is a key component of effective learning. We perform an activity, reflect upon it – what we did right, what we did wrong, and how we may improve on it next time. While reflection is something we all do in our everyday lives, Dick (1993) contends that in action research reflection needs to be far more *deliberate* and *conscious* and interpretations more *sceptical*. Kemmis and McTaggart (1988) add that all the components of action research, including reflection, need to be

carried out more carefully, systematically and rigorously than in everyday existence. In this research individual and collective reflection was formalised through the use of feedback forms which were completed by the co-researchers following fieldwork. Self-reflection was undertaken by the principal researcher and documented in his field notes at the same time and in his journals throughout the research journey.

Reflexivity is also problematic. Heshusius (1994) argues that there has been much preoccupation with how to account for one's subjectivity leading to worry and anxiety amongst researchers trying to restrain and tame it. She argues that subjectivity accounting "*can be seen as a subtle version of empiricist thought, in that it portrays the belief that one knows "how to handle things," that one knows what is "behind" things and "behind" oneself, and how to keep it under control, a belief that was taken to its extreme in the positivist, empiricist tradition*" (Heshusius 1994). Despite the subjective declaration the underlying discourse is still about the egocentric self. She instead advocates a '*participatory mode of consciousness'* where the self-conscious 'I' disappears in favour of self-forgetfulness. The key word she uses is 'merging' – to a state where one is free of ego and embedded in what one wants to understand.

3.5 A convergent evaluation methodology

Both kaupapa Māori research and action research practitioners stress the importance of evaluating the outcomes of the research from the perspective of the participants (Lincoln & Guba 1985; Bishop 1996; Harmsworth 2001,2005; Cram 2016; Bradbury *et al.* 2017; Carlson, Moewaka Barnes & McCreanor 2017). As such, methodologies for evaluating the trustworthiness and rigour of collaborative research projects from both kaupapa Māori and Western perspectives were investigated. Five evaluation criteria offered by Russell Bishop (1996, 1998, 1999, 2005) and further developed by others practice (Cunningham 2000; Te Maro 2010; Haar 2011a,b) for kaupapa Māori research and four offered by Lincoln and Guba (1985) for action research were identified as an appropriate convergent evaluation methodology. The next section outlines the evaluation criteria of the two approaches.

3.5.1 Kaupapa Māori evaluation

The power dynamics inherent in research relationships are highlighted in a kaupapa Māori research framework developed by Russell Bishop (Bishop 1996,1998,1999,2005). He identified five power issues in examining the extent to which ethical research adheres to a kaupapa Māori framework. This is sometimes referred to as the IBRLA framework (Initiation, Benefits, Representation, Legitimisation, Accountability), the questions being (i) Who initiates the research? (ii) Who benefits from the

research? (iii) Who is represented in the research? (iv) Who legitimises the analysis and interpretation of the information? and (v) Who is accountable in the research? Addressing such issues of process and power in kaupapa Māori research is as vitality important to the results, as what is discovered or developed.

The IBRLA framework has subsequently been built upon with additional questions developed according to the context of the research (Te Maro 2010; Haar 2011b,a; Macfarlane & Macfarlane 2018). Haar (2011a, 2011b) highlights implications for undertaking research in Māori communities (initially identified by Irwin (1994)), these being: that research should be (i) "culturally safe"; (ii) have scientific rigour; (iii) be undertaken with a Māori worldview; (iv) have a goal of empowerment; (v) have a whānau focus; (vi) be aligned with the Treaty of Waitangi, and (vii) be undertaken by a researcher with empathy for Māori (Haar 2011b). Cunningham (2000) identified five goals or outcomes of kaupapa Māori relevant to addressing issues of process and power in kaupapa Māori research, these being (i) Māori epistemology; (ii) the Treaty of Waitangi; (iii) Māori development; (iv) capitalising on the investment in Māori medium education; and (v) internationalisation.

Taking Bishop's (1996, 1998, 1999, 2005) framework as a starting point and further populating it with imperatives framed as reflective questions identified in the works cited (Cunningham 2000; Te Maro 2010; Haar 2011b,a) an evaluation methodology is presented to evaluate the success of the research from a kaupapa Māori perspective (Table 2).

Table 2: Evaluation methodology of research success from a kaupapa Māori perspective

Criteria	Related questions
Initiation	Who has conceptualised and initiated the research? ‡ # How did Māori participate in the conceptualisation and initiation process? # Who has designed the research? † Do the research participants have power to be decision-makers? ‡ How was the agreement to proceed with the research achieved? #
Benefits	Does the research support Māori and Māori endeavours and aspirations? ‡ Will the research serve to empower Māori? § Will the research lead to Māori development? * Will the research capitalise on the investment in Māori medium education and build research capacity? *

	Will the research outcomes have international Indigenous applications? *
Representation	Whose voice, interests, needs and concerns are heard? ‡ Does the research have a whānau[60] focus? § Who undertakes the work? †
Legitimisation	Is the data legitimate, valid and robust from a Māori worldview / based on Māori epistemology? * ‡ § Is the research aligned to Te Tiriti o te Waitangi / the Treaty of Waitangi? * § Does the research meet the test of scientific rigour? §
Accountability	Who shares in the knowledge? Who distributes it? Who controls the knowledge? ‡ Is the research process "culturally safe"? § Is the research undertaken by a researcher(s) with empathy for Māori? §

Source: * = Cunningham (2000), † = Bishop (2005), ‡ = Te Maro (2010), § = Haar (2011a, 2011b)

3.5.2 Action research evaluation

There is no single set of criteria used to evaluate the rigour of qualitative research, but rather criteria for 'good' research vary across epistemological standpoints, research traditions and methodologies (Cohen & Crabtree 2006). Lincoln and Guba (1985) argue for alternative criteria for judging the quality of qualitative research which betters reflect its underlying assumptions. They favour the concept of 'trustworthiness' for evaluating the worth of qualitative research. They identify four criteria, these being credibility, transferability, dependibility and confirmability. If these are met, then they contend the research can be considered to be trustworthy. Following Bishop's example for kaupapa Māori, a set of reflective questions has been developed across criteria from which to evaluate the trustworthiness of research from an action research perspective (Table 3).

[60] Whānau ≈ Family

Table 3: Evaluation methodology to evaluate the trustworthiness of research from an action research perspective

Criteria	Related questions
Credibility[61]	Does the research team have confidence in the 'truth' of the findings? "The participants are the only ones who can legitimately judge the credibility of the results" (Trochim 2006). Has the research been member checked? (Lincoln & Guba 1985). Member checking is seen as a most crucial technique for establishing credibility (Cohen & Crabtree 2006). This is when the authenticity of the data, analytic categories, interpretations and conclusions are checked with participants from whom the data were obtained. Has the research been peer debriefed? (Cresswell 2014). Peer debriefers review and ask questions about the study so that the account resonates with people other than the researchers.
Transferability	Can it be demonstrated that the findings have applicability in other contexts? Qualitative inquiries are often specific, and the findings applicable to a particular time, setting, situation, or a small group of individuals. Cohen and Crabtree (2006) contend that by describing a phenomenon in sufficient detail (thick descriptions) one can begin to evaluate the extent to which the conclusions drawn are transferable to other situations and populations.
Dependability	Can it be shown that the findings are consistent and could be repeated? Has an external audit trail been carried out? "*External audits involve having a researcher not involved in the research process examine both the process and the product of the research study. The purpose is to evaluate the accuracy and evaluate whether or not the findings, interpretations and conclusions are supported by the data*"(Cohen & Crabtree 2006).
Confirmability[62]	Has the research involved reflexivity to attend to researcher bias? Can the research be triangulated? Can it be shown that there is a degree of neutrality to the research, with the findings of the study shaped by the respondents and not researcher bias, motivation, or interest? (Cohen & Crabtree 2006).

[61] Credibility is the parallel concept of 'internal validity' in quantitative research
[62] Confirmability is the parallel concept of 'objectivity' in quantitative research

3.6 Summary of the theoretical framework

In this chapter two research methodologies have been outlined. One, kaupapa Māori, is rooted in an Indigenous tradition. The other, action research, is a critical approach from the Western scientific tradition. There are well-established characteristics, processes and models both for kaupapa Māori and action research as outlined and described. They provide the researcher with ample guidance on what to consider and how to proceed in the research process. There are overlapping principles, so there are sound reasons to work the approaches together. The *Emancipation of participants for social change* theme of action research resonates with the kaupapa principles of *Tino rangatiratanga, Taonga tuku iho* and *Kia piki ake I ngā raruraru o te kāinga. Ako Māori* and *Experiential learning* have much in common, as do the kaupapa Māori principles of *Whānau* and *Kaupapa* and the action research theme of *Collaboration through participation*. The principle of *Āta* and the theme of *Critical reflection* share guidance on self-reflective inquiry. Bringing these traditions together provided fertile ground for growth in understanding and guided the research activities.

Both kaupapa Māori and action research methodologies emphasise the importance of evaluating the success of the research from the perspective of the participants. A convergent kaupapa Māori - action research evaluation methodology was identified drawing upon good practice guidelines from two traditions. A kaupapa Māori set identified by Bishop (1996) can be used to determine the success of the research from a kaupapa Māori perspective, and a complementary set of questions to determine the trustworthiness of the research from an action research perspective (Lincoln & Guba 1985). An evaluation of the research practice using the convergent evaluation methodology described is undertaken in Chapter 5, Section 5.7.

In the next chapter, Chapter 4, the Methodology and study forests are outlined. This includes the iwi engagement methodology, the catchment and the forests in which the research was undertaken.

Chapter 4

Engagement methodology and case study forests

"The case study approach is an important approach used in this research to collect and document information showing how Mātauranga Māori is used in a real-life and practical context." (Awatere *et al.* 2013)

4.1 Introduction

This research utilises a case study approach involving a collaboration of three iwi groups, an immersed researcher from Lincoln University and six indigenous forests in the Motueka – Riwaka catchment. The research steps are outlined in Figure 5 with the steps covered in this chapter (Chapter 4) shaded in blue with those in yellow being covered in Chapter 5.

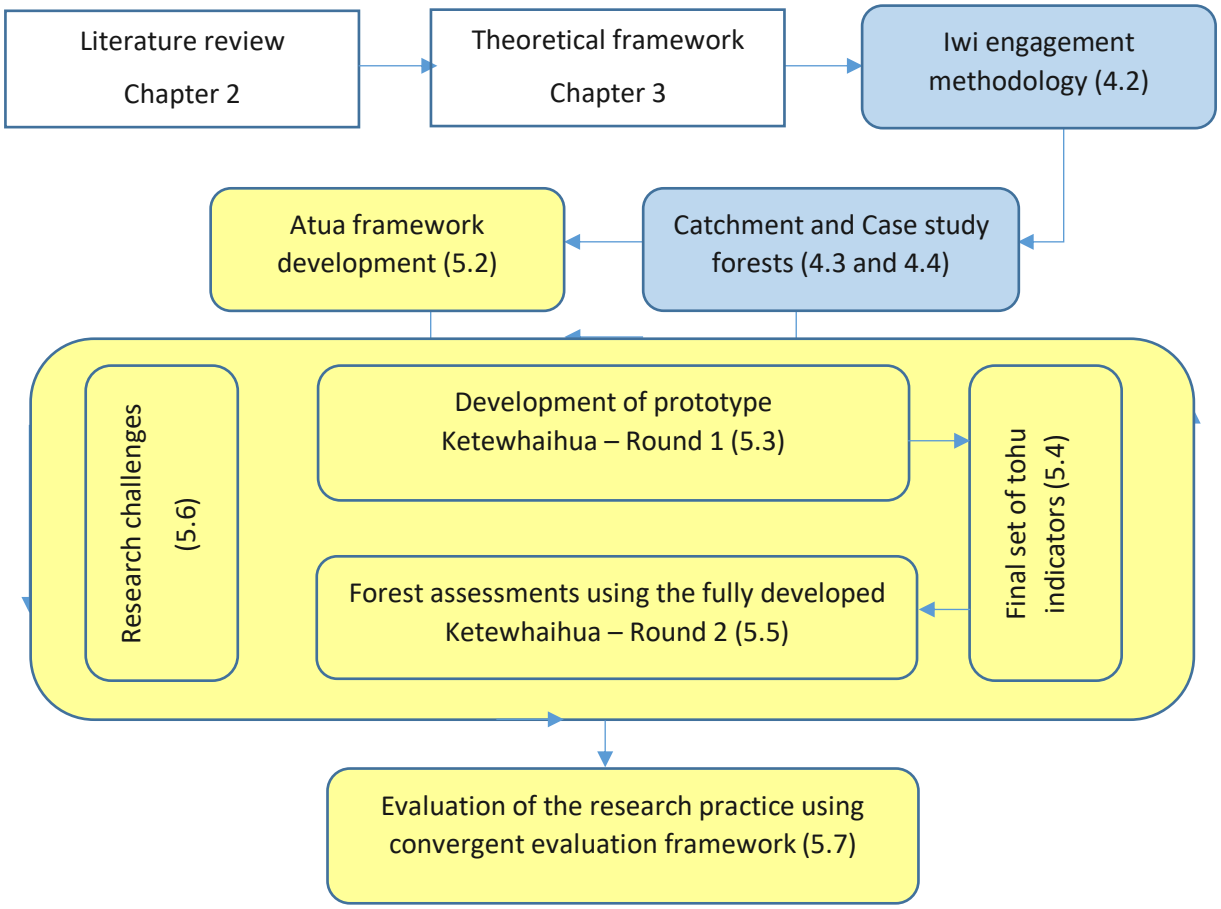


Figure 5: Research steps (blue shaded steps are covered in this chapter, yellow in the next chapter)

A brief introduction of each research step follows.

1. **Literature review:** A review of international and New Zealand culturally-based monitoring approaches to monitoring the health of biodiversity (Chapter 2).

2. **Theoretical framework:** The study is underpinned by a theoretical framework incorporating both kaupapa Māori and action research methodologies as outlined in the previous chapter (Chapter 3).

3. **Iwi engagement methodology:** The development of a collaborative research process with three iwi groups in Te Tau Ihu in partnership with Lincoln University (Chapter 4, Section 4.2).

4. **Catchment and Forest selection:** The selection of six study forests in the Motueka – Riwaka catchment based on a range of physical and cultural variables including forest types, land uses and management regimes (Chapter 4, Sections 4.3 and 4.4)

This chapter details research steps 3 and 4 above followed by a Summary (Chapter 4, Section 4.5).

4.2 Iwi engagement methodology

One of the research questions posed is *'What is an appropriate methodology for the engagement of Māori and scientists in a natural resource management project?'* This section provides an outline of the engagement methodology developed and applied in this project. The seeds for this research were sown at a kaitiaki environmental indicators hui[63] held at Te Āwhina Marae[64] in July 2008. Building on their work on culturally-based environmental indicators for freshwater as part of the Motueka ICM programme, participants at the hui considered the development of a tool to assess the cultural health of ngahere[65] to be a high priority. An outline of a research proposal was presented by the principal researcher to Tiakina te Taiao[66] in Richmond in November 2010 for discussion. Advice was received from Tiakina te Taiao that approaches by the principal researcher should be made directly to each of the manawhenua iwi in the Motueka - Riwaka catchment to seek a working relationship for the research.

Discussions with the principal researcher and four iwi groups ensued through 2011 with three groups deciding that they had the personnel and capacity to support the research - Te Ātiawa Manawhenua kit e Tau Ihu Trust[67], Ngāti Tama ki Te Waipounamu Trust, Te Rūnanga o Ngāti Kuia Trust. A research

[63] Hui ≈ meeting
[64] Marae ≈ the open area in front of the meeting house (Marae ātea). Often also used to include the complex of buildings around the marae
[65] Ngahere ≈ indigenous forest
[66] Tiakina te Taiao is a tribal resource management entity in the Nelson - Motueka area made up of representatives of four tribes and two tribal corporates.
[67] Now called Te Ātiawa o Te Waka-a-Māui Trust

proposal and memorandum of agreements (MoAs) were developed with each of the iwi entities. The processes were slightly different for each iwi though in the first instance this involved attendances at each of their regular trust board monthly hui and thence after through delegated representatives. Four kaitiaki – Pat Park, John (JK) Katene, Maui (Jason) Duff, and Ray Anderson were mandated by their iwi to a core research team along with the principal researcher, Dean Walker (Lincoln University (Plate 1)).

Plate 1: The core research team (l-r): Ray Anderson (Ngāti Kuia), Pat Takarangi Park (Te Ātiawa), Maui (Jason) Duff (Ngāti Tama), John (JK) Katene (Te Ātiawa), and Dean Walker (Lincoln University).

The MoAs set out the terms and conditions for participants in the research highlighting issues of representation, legitimacy and accountability. Included in the MoAs are a general outline of the project, terms of the project and communication protocols. The principal researcher agreed to update each of the iwi trust with six monthly progress reports as well as face-to-face meetings as required. After initial enthusiasm, Ngāti Rarua decided to withdraw their participation in the research, but not their general support of the project. They cited resourcing difficulties as they were in the midst of Treaty claims at the time. Ngāti Tama actively participated in the development of the research and MoA. They later decided not to sign a MoA citing issues with the three-way nature of the agreement, however they still mandated a kaitiaki to the research team as well as a kaumātua

(Fred Te Miha). The principal researcher was supported by an academic supervisory team of three, including two Māori academics from Lincoln University. A mutual expectations agreement outlines the responsibilities of the academic team. The project and MoAs were approved by the Human Ethics Committee of Lincoln University. Figure 6 represents the relationships between the parties in the research and the mechanisms which formalise these relationships.

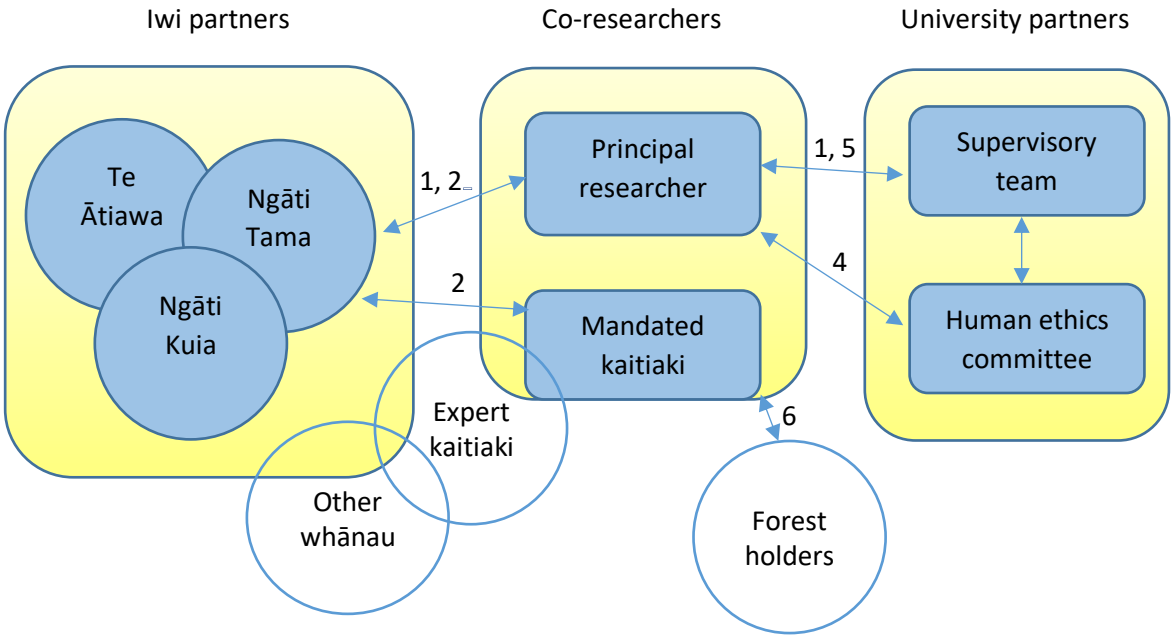


Figure 6: A framework of formal relationships between the parties in the research.

The numbers in Figure 6 relate to the mechanisms which confirm the roles and responsibilities of the research parties, these being, 1: Memorandum of agreement, 2: Communication protocol, 3: Informed consent document, 4: Human ethics approval, 5: Mutual expectations agreement, 6: Letter of engagement. The entities with the solid fill represent are formalised relationships and those with no fill are less formal relationships.

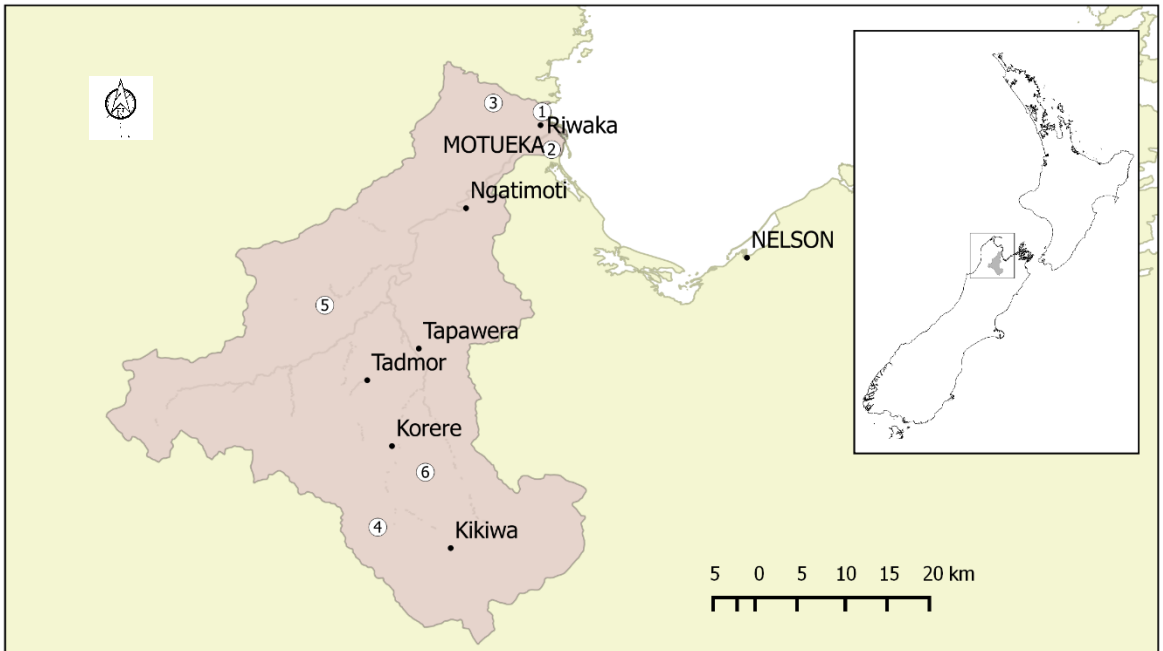
The four kaitiaki mandated to the core research team[68] by their respective iwi trusts are all Motueka residents with long-term connections to the catchment. Their appointments were based on a range of skills and experience. Pat Park and John Katene have prior practice developing culturally-based tools and undertaking environment monitoring through the Motueka ICM programme. Both have extensive experience as kaitiaki working for their iwi in a variety of resource management roles. Maui Duff is based at Te Āwhina Marae with particular strengths in tikanga Māori and traditional uses of plants. Ray Anderson brings to the team practical experience in forestry. Kaitiaki were supplied at the initial research meeting with an outline on the research project, focused around the building of a toolkit for the monitoring the health of indigenous forests from an Indigenous Māori

[68] The core research team included the four mandated kaitiaki alongside the principal researcher

perspective. The roles, rights and responsibilities of kaitiaki as co-researchers were discussed. This included the responsibility to update their respective trust boards on the research progress (generally through attendance at their monthly trust board hui) and make contact with appropriate kaumātua and kaitiaki who may be able to assist in the research. Invitations to participate in the research were presented along with a consent form to confirm participation. At the invitation of the kaitiaki other tribal members with speciality knowledge, and younger family members participated in hui and site visits. Letters of engagement were developed and sent to each of the Round 2 forest owners, outlining the nature of the research and requesting their participation.

4.3 The Motueka – Riwaka Catchment

The Motueka - Riwaka Catchment is located in Te Tau Ihu o te Waka a Māui (the top of the South Island) (Figure 7).



ID	Forest name	Landholder	Land use	Forest type	Forest stage	No. of visits
1	Puketawai	Dept. of Conservation/ Iwi	Conservation	Scrub/ black beech	Regenerating	2
2	Te Maatu/ Thorps	Tasman District Council	Recreation	Podocarp - hardwood	Old growth	2
3	Moss Reserve	Dept. of Conservation	Conservation	Podocarp	Regeneration	2
4	Kaka Hill	Private	Production	Mixed beech - podocarp	Old growth	1
5	Te Kaainga Tawhai	Private QEII Trust	Conservation	Beech - rata	Old growth	1
6	Brewerton's	Crown Forest Licence	Conservation	Mixed beech	Old growth	1

Figure 7: Map of forest locations and table of key attributes

Four main tributaries drain from tussock covered mountains, through forested hills and across flat terraces and flood plains into Tasman Bay. The area has a rich Māori history promulgated by its rich natural resources and an amenable climate, dating back to prior to 1350. It is one of the few catchments within Te Tau Ihu o te Waka a Māui where all eight manawhenua iwi have an overlapping connection (Te Puna Kōkiri 2005). The Motueka – Riwaka catchment was chosen as a study area due to the involvement of manawhenua iwi in the Motueka Integrated Catchment Management (ICM) programme and their research and development of culturally-based tools for monitoring freshwater (Harmsworth *et al.* 2011). The programme ran from June 2000 to September 2010[69]. It involved collaborative research projects between scientists, manawhenua iwi and community groups, so the choice of the Motueka – Riwaka catchment draws upon the intellectual knowledge built by this legacy and a desire by the research partners to continue to build capability and capacity within tribal groups in the area. Physically, the catchment is 2180 km² in area, aligned roughly north south, being 75km at its longest point and 40km at its widest (Figure 7). Environmentally the catchment is very complex. Elevation ranges from sea level up to 1850 m. The mountains to the west attract more than 3500mm of rainfall per annum, whilst in the lowlands to the north this falls to 950mm. Geologically the catchment has a wide range of rock types, including granites in the Western hills, ultramafic rock in the east and alluvium in between. The range of soil types reflect the complexity of the underlying geology, landforms and climatic gradients. Vegetation in the catchment is dominated by indigenous forest (35% by area), mainly mixed *Nothofagus* (southern beech) forest on hill country, with occasional remnants of mixed podocarp (rimu (*Dacrydium cupressinum*), kahikatea (*Dacrycarpus dacrydioides*) and tōtara (*Podocarpus totara*) forest, which formerly covered the lowland areas draining to swamps in low-lying and coastal areas (Basher 2003).

The Motueka – Riwaka catchment is sparsely populated with a total population of some 12,000, most of who live in the hub town of Motueka. The rural population density is about 2 persons per km². A large part of the catchment is held within the Crown conservation estate (55%) mainly in the mountain and hilly areas (forest, scrub and tussock grasslands). Forestry makes up 25% of the land use, with *Pinus radiata* the major tree crop. Sheep and beef farming forms about 19% of the remaining area, with limited but increasing hops, dairying, pip fruit, berry fruit and vegetables.

[69] http://icm.landcareresearch.co.nz/

4.4 Case study forests

Six forest sites were chosen for study across a range of forest-holders, land uses, forest types and stages of forest succession (see table inset in Figure 7 above). Forest visits were carried out in two rounds, with the first three forests also selected on their cultural significance (Puketawai, Te Maatu and Moss Reserve) being visited twice each, and the second three forests making use of existing iwi forest-holder relationships (Kākā Hill, Te Kāinga Tawhai and Brewerton's Forest) being visited once each.

4.4.1 Puketawai

Puketawai is located near the mouth of the Riwaka River. A scrub covered hill makes up most of the 12-hectare site, mainly gorse and regenerating native scrubby hardwoods. The site has great cultural significance to Te Ātiawa, Ngāti Rarua and Ngāti Tama in particular, with pa terraces, burial caves, food storage pits and a stone tool working area still evident. There is a small area of old growth black beech forest at the toe of the hill giving way to wetland and flats. The low-lying former estuarine area was previously a council rubbish dump. The site has been a focus of cultural and ecological restoration for the iwi groups cited. The Wai-atua Stream which bisects the wetland and flats is a freshwater monitoring site for iwi. The historic reserve was held by the Department of Conservation managed by the Kaiteriteri Recreation Reserves Board for many years. Puketawai was subject to a Treaty of Waitangi claim. During the course of this work the claim was settled and Puketawai was returned to the three iwi cited.

4.4.2 Te Maatu

Te Maatu, also known as Thorpe's Bush is located in the heart of Motueka. It is a small remnant (4.5 ha) of the much larger Te Maatu (The Big Wood) forest of mature mixed lowland podocarp forest of pre-European times. The site is important to tangata whenua being a connection to their ancestors and a significant resource which was integral to their survival. The dominant species of Te Maatu today are tōtara and the hardwood tītoki. Te Maatu is an island of old growth forest surrounded by a sea of houses and home gardens. It is managed by Tasman District Council as a local purpose reserve and is a popular town park for passive recreation. A stream flows alongside the edge of the forest, but it is little more than a storm water overflow drain now, although it is used as a freshwater monitoring site by iwi.

4.4.3 Moss Reserve

Moss Reserve is located approximately 4 km upstream of the Riwaka River mouth. It is approximately 25 hectares in size, bisected by the Riwaka Valley Road. The cultural significance of the forest is that it is en route to Te Puna o Riuwaka (the Riwaka Resurgence) which is a special place of healing for tangata whenua. River flats on the river side of the road are mainly pole stands of kahikatea, some regenerating through old bankside plantings of willow, with the occasional mature kahikatea present. On the other side of the road is a hillside of mature mixed beech forest with the occasional rimu. The Department of Conservation is the forest-holder and the status of the site is scenic reserve. As well as the forest described there are large areas of mown grass on the river flats, which attracts picnickers and freedom campers over the summer.

4.4.4 Kākā Hill

Kākā Hill is located in the Rainy River area in the Motupiko catchment. The forest is 120 ha in size with an altitudinal range of 390 to 610 m above sea level. The forest is effectively an island of indigenous forest surrounded by a sea of plantation pine forest and farm land, though there are some minor connections to other adjacent native forests. It is classified as a mixed beech/ podocarp forest. Rimu is the dominant podocarp but only makes up a small component of the forest due, in part, to periodic harvesting in the past. It is a private forest, managed for small scale timber production and conservation purposes. The forest-holders are Dean Walker and Suzanne Bateup. Horopito Stream flows from the nearby Big Bush Conservation Forest through a section of pine plantation to Kākā Hill.

4.4.5 Te Kāinga Tawhai

Te Kāinga Tawhai is located in the Clarke Valley in the Baton sub-catchment with an altitudinal range of 270 – 450 m above sea level. The forest is around 40 ha in size but is ecologically larger because of its connection to Kahurangi National Park along a long shared boundary. The forest is typed as mixed beech/ podocarp/ rata. The podocarp component is mainly kahikatea located on river flats. The dominant cover of adjacent land is native forest and scrub. The forest is a private landholding managed primarily for conservation purposes under a Queen Elizabeth II Trust covenant. The forest-holders are Scott Nicol and Maria Deutsch.

4.4.6 Brewerton's Forest

Brewerton's Forest is located in hills near the Motupiko River – Upper Motueka confluence, with an altitudinal range of 420 – 520 m above sea level. The forest is around 140 ha in size consisting of two

blocks draining into two separate catchment areas (Long Gully Stream and Brewerton Creek Left Branch) bisected by a series of forestry roads. The forest is completely surrounded by pine plantation which had recently been clear-cut at the time of investigation. It is composed of mixed beech with patches of rimu on favourable sites. The forest is held by the Crown and managed by Nelson Forests Ltd (NFL) under a Crown Forest Licence. Brewerton's Forest is used for conservation offset purposes which assists NFL to meet biodiversity protection obligations under the Forest Stewardship Council certification scheme, the Tasman Accord and the New Zealand Forest Accord.

4.5 Summary

In this chapter the case study was described with the first step (parallel with the literature review and development of theoretical framework) being the development of an iwi engagement methodology for the research collaboration (Chapter 4, Section 4.2). The collaboration involved iwi partners (three iwi groups in Te Tau Ihu), university partners (supervisory team and human ethics committee) and co-researchers (mandated kaitiaki and the principal researcher). Expert kaitiaki, whānau members and forest-holders were called upon as required to provide advice, support the research and engage in preferred ways of learning. Memorandums of agreement, communication protocols, informed consent documentation, human ethics approval and mutual expectations agreements formalised the relationships between the various parties.

The cultural and physical features of the Motueka – Riwaka catchment and the six study forests were described along with the rationale behind their selection (Chapter 4, Sections 4.3 and 4.4). The reason for the selection of the Motueka – Riwaka catchment was primarily to continue to build the research capability of manawhenua iwi of the Motueka, first initiated through the Motueka ICM programme (2001 – 2011). In terms of forest selection, a range of forest types and conditions were sought to test the transferability of the toolkit.

In the next chapter, the yellow shaded research steps outlined in Figure 6 are described, starting with the further development of an Atua framework and development of a prototype toolkit through to a fully functioning Ketewhaihua. The chapter concludes with a description of the research challenges faced and an evaluation of our research practice.

Chapter 5

Development of the Atua framework and the Ketewhaihua

"*Ranginui (Sky father) looked down upon Papatūānuku (Earth mother) and, loving her, descended and mated with her". "Locked in deep embrace they produced numerous progeny (in some accounts 70 in number) all of whom were male". "These offspring were imprisoned between the primeval parents in stifling darkness. Faint glimpses of light filtered in and the children became restless and anxious to escape to the world of light (Te ao mārama)"* (Irwin 1984).

Several failed attempts were made to separate Rangi and Papa but they remained resolute in their tight embrace of each other. *"Tāne* (Atua of the birds and the forests) *proposed to his brothers that their parents should be separated – that the Sky should be forced upward that they might enjoy the freedom of movement and the air of space"* (Best 1978). But not all of Tāne's brothers agreed to the separation. "*Whiro* (Atua of darkness and evil) *was the leader of the opposition against Tāne".* (Hiroa 1949). Tāwhirimātea deity of the winds and storms, Uru-te-ngangana of the heavenly bodies, and the unborn Rūaumoko of volcanoes and earthquakes also voiced their objection.

"Finally, Tāne lay down on Papa, bracing his feet against Rangi and extending his arm against Papa. Upside down and struggling fiercely, with the brothers giving him support as they were able, the reluctant parents were inexorably forced apart" (Irwin 1984). Following the separation Tāwhirimātea sided with his father in the skies. "*There he begat and raised the Wind Children and attacked his brothers on earth,*" (Hiroa 1949).

Rongo the peace maker tried to calm Tāwhirimātea and his brothers but without success. Tangaroa (Atua of oceans and water ways) fled and hid in the sea. "*Rongo* (also the Atua of agriculture) *and Haumie* (Atua of fern root and wild foods) *took refuge in the body of Papa who hid them until the storm passed"*(Orbell 1998). "*However, when Tūmatauenga also attacked his brothers, Haumie's hiding place was discovered by his (*bracken fern) *hair"* (Hiroa 1949). Whiro also retreated to the earth for his love of dark places.

"*Rūaumoko was still in the womb when his parents were separated, so he remains there now. When he moves around inside his mother, there are earthquakes. By shaking her and turning her over, he divides the warmth of the summer from the cold of winter"*(Orbell 1995).

"Following the forcible separation, Rangi and Papa grieved for each other, Rangi's tears becoming the rain and Papa's the rising mists." (Irwin 1984).

5.1 Introduction

This chapter outlines the development of the Ketewhaihua (including the resulting Atua framework, tohu and method) from an early prototype to a fully functioning toolkit. This section also has the objective of, in part, answering the research question '*From a Māori perspective what is an appropriate framework and suite of indicators for culturally-based monitoring?'* Challenges to the tool development are described as well as an evaluation of our research practice. A brief introduction of each of the next research step follows. These steps are shaded yellow in Figure 5 at the beginning of the previous chapter (Chapter 4, Section 4.1).

1. **Atua framework development:** The consideration of a range of kaupapa Māori frameworks currently in use in New Zealand and the development of an Atua framework based on the wisdom of the ancestors (Chapter 5, Section 5.2).

2. **Tohu development – Round 1:** The identification of a potential set of culturally-based tohu and the trialling of a prototype Ketewhaihua at Puketawai, Moss Reserve and Te Maatu (Chapter 5, Section 5.3).

3. **Final set of tohu:** A brief commentary on the development of the tohu contained within the Ketewhaihua according to domain Atua (Chapter 5, Section 5.4).

4. **Forest assessments using the fully developed Ketewhaihua – Round 2:** Following the confirmation of the prototype Ketewhaihua in Round 1, three forest health assessments were carried out at three 'hinterland forests', Kākā Hill, Te Kāinga Tawhai and Brewerton's Forest (Chapter 5, Section 5.5).

5. **Challenges:** The challenges to the research are outlined including tohu development, species identification, data collection sheet and method, absenteeism and, timing of assessments (Chapter 5, section 5.6).

6. **Evaluation of the research practice:** A reflexive evaluation of our research practice is carried out (Chapter 5, Section 5.7) using a convergent kaupapa Māori – action research evaluation framework outlined in Chapter 3, Section 3.5.

5.2 Development of the Atua framework

Conceptual frameworks and models are often used in research to help increase understanding of ideas and explain or expand upon theory. They are particularly favoured in multidisciplinary research (Ilott *et al.* 2013). Frameworks and models "*are tools to structure thinking and action about a problem. They provide a rationale, to justify decisions and explain findings*" (Ilott *et al.* 2013). In this research step, a range of scientific and kaupapa Māori frameworks were considered by the research team, to help provide structure to a set of indicators and inform the development of a culturally-based monitoring toolkit or *Ketewhaihua*. While the number of scientific forest assessment methods and tools available in Aotearoa New Zealand are extensive, as outlined by Handford (2000), most focus on specific parts of forest ecosystems or specific biodiversity threats rather than cover a holistic assessment of forest health. The Bush Vitality (Janssen 2004) and FORMAK (Handford *et al.* 2004) kits are exceptions. FORMAK incorporates aspects of mātauranga Māori into its kit including whakataukī and some headings in te reo Māori however, it is essentially a Western approach that has been indigenised to an extent. Both methods are used to collect a wide range of information on forest ecosystem health however, we found that they both lacked a holistic te ao Māori understanding of what may be considered to be appropriate indicators of forest health.

Kennedy and Jefferies (2007) identified three types of kaupapa Māori models; the cosmological (Atua-based), the classification of time (Wā-based) and the tikanga (values-based) models. They acknowledge that there are often overlaps between the three. The three models were considered in this research as a way to structure the toolkit and the tohu, and to inform the development process. After discussions of frameworks and their attributes amongst the research team, an Atua framework was seen to be the most culturally appropriate from a mana whenua ki Motueka perspective. An Atua framework is familiar to the iwi groups involved in the project. It is used for a range of resource management activities including framing cultural impact assessments (e.g. Walker & Bunt 2006), culturally-based monitoring (e.g. Young *et al.* 2010) and the Nelson Iwi Management Plan (e.g. Passl 2004). Pat Park and John Katene were familiar with the application of an Atua framework for all three uses and readily explained the use of this framework to Ray Anderson and Maui Duff. Ray and Maui were familiar with the traditional creation narratives and the interrelationships of the seven Atua but they did not have experience of the Atua framework being used for kaitiakitanga purposes.

A prototype Atua framework was developed during 2013, in conjunction with the rounds of fieldwork and associated hui. The prototype built upon Passl (2004) (Figure 3 in Chapter 2, Section 2.4), first conceptualising it as a Venn diagram of seven intersecting circles each representing an Atua but soon after as an hexagonal arrangement centred around Tāne, the change in design both

emphasised the individual mana of each Atua as well as the connections between them. The hexagonal arrangement of the framework has a quality of strength manifest in bee hives, basalt columns and other building blocks of nature. The triangular shape, niho taniwha[70] is also a symbol of strength and resilience. It has contextual meanings variously including the historian, the chief, hospitality and family houses within a tribe (Department of Maori Studies 1986). In the context of this framework the triangle also symbolises of the strength of a three-way kōrero between the Atua, the kaitiaki and the tribe. Tāne is in the centre, as the agenda at hand is within his domain. The research team quickly realised that as well as assisting in the identification and structuring of a suite of indicators the prototype Atua framework also functioned as a learning tool. Post fieldwork the principal researcher later developed an illustration of the Atua framework to include culturally relevant symbols and improve its effectiveness as a cultural lens and cater for a variety of learning styles (Figure 8).

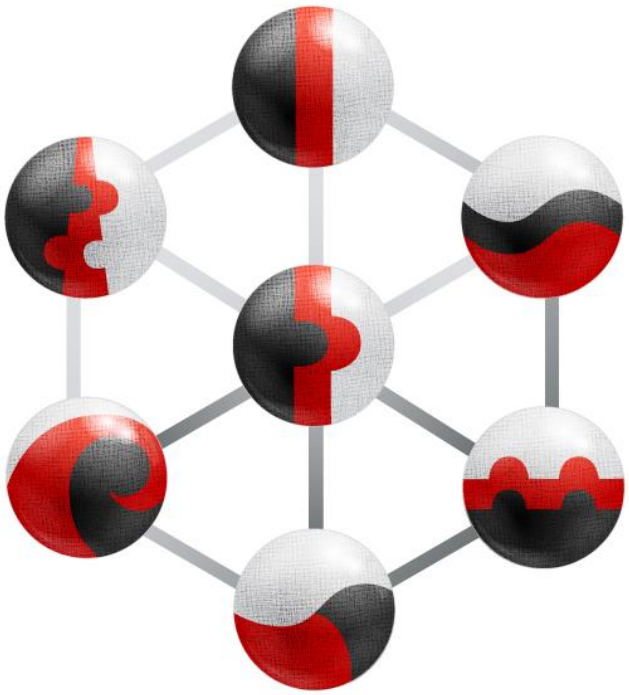


Figure 8: Atua kaitiaki framework

Black, red, white represent the past, the present and the future. They also represent Papatūānuku, Ranginui and the physical realm of light and being (Te Ao Mārama) created when they were separated.

[70] Niho taniwha ≈ Saw-edged or triangular pattern. Literally the 'tooth of the supernatural being'

Tangaroa is Atua of oceans and inland waterways. Here the curl of a wave, an eddy and a horizon over the sea are envisaged. The land is steadily being eroded by the sea.

Tāne is Atua of forests and birds, and is the fertility force. The vertical lines are trees in the forest. The 'bumps' are burls and birds on their trunks, and the bellies of pregnant women. Tāne holds the realm of the day (white) and Hine-nui-te-po the night (black). Te Atapō (red) is the instance of time, which belongs to neither.

Tāwhirimātea is Atua of the winds and storms. The weather is his domain. The colours depict cloud types and winds, the faces climate change conversations

Tūmatauenga is Atua of people and war. His issues are political and social. Black and white represent two opposing sides of a conversation, the red the way forward.

Rongomātāne is Atua of agriculture and peace. The black is the earth, the red the kumara beneath and the white the taro leaf overhead. The symbol emphasises harmony, balance and kotahitanga[71].

Haumietiketike is Atua of fern root and wild foods. Haumie's hair is depicted as the bracken fern shoots unfurling from the soil.

Rūaumoko is the unborn, Atua of earthquakes, volcanoes and other geological phenomena.

Te Kapunga Dewes (1977, p.46) said that the transmission of Māori knowledge "rests on the foundation of te reo Māori" (in Pihama *et al.* 2004). The common language in the framework is one of symbols rather than the written word. The framework can be interpreted through different

[71] Kotahitanga ≈ Unity, collective action, holism

learning styles, ways of knowing and languages. For dissemination purposes the framework is depicted as two-dimensional geometrical shape. However, formalising this framework in this way does not necessarily convey the fluid nature of this model or capture the complexity, the connectedness or inter-relatedness of the Atua and the inherent strength of the Māori worldview.

While these Atua are generally recognised throughout Aotearoa New Zealand their names, relationships and importance can vary between tribes. Māori trace their ancestry through the many progeny (children and grandchildren) of these Atua. Best (1924) referred to them as 'tribal gods', because they are usually recognised by a single tribe or group of tribes rather than being universally known. They are also variously referred to as taniwha[72], kāwai tūpuna[73] and poutiriao[74] (Hiroa 1949). The term poutiriao was favoured in this project. Poutiriao were located within the Atua framework, positioned close to their tīpuna[75] as were 'species' of flora, fauna, minerals, etc., associated with their roles. There are significant variations in traditional narratives, taxonomy of 'species' and roles of poutiriao between various iwi and hapū throughout Aotearoa New Zealand. In some traditions the kaitiaki of reptiles is known as Tū-te-wehiwehi and in others Tū-te-wanawana (Orbell 1995; Roberts *et al.* 1995). Punga is often referred to as the parent of ugly creatures, however, in other traditions he (or sometimes she) is variously depicted as the guardian of insects, reptiles or sharks (Orbell 1995). The Atua framework illustrated is more fluid with overlapping boundaries between Atua. Tūtewehiwehi of reptiles for example, who through his whakapapa occupies space between Tangaroa and Tāne, rather than being contained within a single domain. Similarly, Punga of insects could also fall within either of these domains, with many insects spending at least some of their lifecycle in water. For the purposes of this toolkit the research team felt that the children of Tūtewehiwehi and Punga would best be considered within the cohort of Tangaroa.

5.3 Development of prototype Ketewhaihua – Round 1

The next stage of the methodology was the consideration and confirmation of a workable and manageable suite of tohu to form the basis of a prototype Ketewhaihua monitoring toolkit. The Atua framework was used by the research team to 'consult' with each Atua in turn as a holistic method for determining a range of tohu covering a range of domains and interrelationships. A summary of the methods utilised by the core research team in Round 1 forest visits is outlined below. These are not necessarily in chronological order as they were undertaken through an iterative cyclical process.

[72] Taniwha ≈ Powerful, sometime dangerous, creature, spirit or guardian
[73] Kāwai tūpuna ≈ Literally line of descent, ancestor
[74] Poutiriao ≈ spiritual guardian
[75] Tīpuna (also tūpuna) ≈ ancestors

1. Identified a draft set of tohu inspired from the literature and the collective experience of core team members,

2. Used the Atua framework to help arrange the suite of tohu in cohorts according to Atua kaitiaki with appropriate poutiriao, key words or phrases and whakataukī identified for each tohu,

3. Developed a draft data collection method (prototype Ketewhaihua), to collect both qualitative and quantitative data for each tohu. Brief poetic narratives, such as whakatauākī[76], were favoured as culturally appropriate and efficient ways to record the kōrero[77] and distil the essence of the state of health of each tohu. Two methods for quantifying the state of health of tohu by rating them using Likert metrics (1 to 5 and -2 to +2) were tested for their ability to best reflect the culturally significant concepts of mauri and wairua,

4. Developed and built upon existing tikanga[78] and health and safety protocols to keep research team members physically and culturally safe, particularly in the field.

5. Used a cyclical iterative action research process to trial the draft tohu and prototype Ketewhaihua, twice at each of three forest (Puketawai, Te Maatu and Moss Reserve) over the summer, autumn and winter months. The three forests are local to the township of Motueka with kaitiaki all being residents and having personal and tribal connections to the forests. A typical action research spiral was, Plan (hui to discuss set of tohu and Ketewhaihua) → Act (apply tohu in the field) → Observe (which tohu worked, and which did not) → Reflect (accept, modify, merge or reject tohu and Ketewhaihua) → Plan.

6. Following each forest visit both qualitative and quantitative data from the data collection sheets were transferred to an XL spreadsheet and the following data management steps undertaken.

    a. Scores made by each kaitiaki were recorded in raw from. From this the mean scores for each tohu and the range of scores across the kaitiaki were derived.

[76] Whakatauākī ≈ attributed saying or proverb
[77] Kōrero ≈ Narrative, discussion, discourse
[78] Māori customs and protocols

b. Triangulation was undertaken. Each kaitiaki's score was mapped against what they said. Incongruities signalled a lack of understanding of the tohu or how to score it.

c. The range of scores for each tohu were analysed. A range between 0 and 1 point between the highest and lowest scores signalled strong consensus between kaitiaki on how to score the tohu in question. These tohu were contenders for confirmation in the final suite. A range greater than 1 and less than 2 points between the highest and lowest scores were contenders for modification. A range greater than 2 points between the highest and lowest scores signalled a lack of consensus between kaitiaki and were contenders for discontinuation.

d. Tohu were either confirmed, modified or were discontinued based on steps b and c above.

e. Field reports were prepared including a summary of data collected across the seven Atua, feedback from kaitiaki on their views of the developing tool, and a summary of findings to date and recommendations, particularly around the modification or d of tohu being trialled. Field reports were circulated to team members for discussion at hui and verification prior to the next round of fieldwork.

7. After the six forest visits and associated hui confirmed a final suite of workable and culturally appropriate tohu and Ketewhaihua for assessing the state of health of indigenous forests.

Each of the methods described above are detailed in the reminder of this chapter section, including how they evolved and were applied, starting with the non-fieldwork actions followed by actions from each day's fieldwork.

Not everything can be monitored so a range of appropriate tohu needed to be determined, but not too numerous in number to be unmanageable. The cultural health index developed by Tipa and Teirney (2006a) for freshwater utilises eight key indicators. Tiakina te Taiao use 24 indicators in both their freshwater and estuarine monitoring regimes with around four sites being monitored per day (Harmsworth et al., 2011; Walker, 2009a). An initial set of 35 tohu were identified as possible candidates from which to form a holistic Ketewhaihua drawing upon a review of current culturally-based monitoring and citizen science monitoring approaches and the experience of research team members Pat Park, John Katene and the principal researcher, all of who had been involved in other culturally-based monitoring research projects and cultural impact assessments in the region (e.g. Walker & Bunt 2010; Harmsworth *et al.* 2011). The review included a cultural health index for streams and waterways (Tipa & Teirney 2006b); iwi indicators for estuaries (Walker 2009); linkages

between cultural and scientific indicators of river and stream health (Harmsworth *et al.* 2011); cultural indicators for kauri forests Shortland (2011b); and a cross-section of cultural values reports from the Motueka-Nelson region (e.g. Passl, 2004; Walker & Bunt, 2006; Walker & Bunt, 2010). Citizen science toolkits for indigenous forests in current use in New Zealand were also reviewed for complementary indicators (Handford 2000; Handford *et al.* 2004; Janssen 2004)[79].

Kennedy and Jefferies (2009a) contend that the design of cultural indicators need to be SMART. That is, *"Specific (closely related to the theme or outcome it will measure), Measurable (data are available), Achievable (it is possible to reach targets that have been set based on the indicator), Relevant (to those who will use them), and Time-bound (to show trends)".* Hughey, Booth and Baker (2010) add A – "*may be Already in use*" to the criteria to get SMARTA. In a review of Māori environmental monitoring in New Zealand, Harmsworth and Tipa (2006) found that to be effective Māori environmental indicators need to be simple, robust, meaningful, and defensible and able to be monitored at a reasonable cost. From the review they identified a list of criteria for selecting effective Māori indicators, these being:

- Based on tikanga (follow iwi or hapū rules and values),
- Based on information that is still available/ obtainable (e.g., mātauranga Māori, knowledge that is in current existence),
- Meaningful to tangata whenua/ iwi/ hapū/ rūnanga,
- Able to be assessed, measured and interpreted by local and other Māori groups,
- Cost-effective,
- Repeatable and consistent,
- Able to show environmental change in two directions: positive (e.g., enhanced), the same (maintained), or negative (e.g., degraded),
- Able to show gradational, incremental, or orderly change, ranging from qualitative to quantitative,

[79] Bush Vitality Kit
Janssen, H. 2004, *Bush Vitality: A visual assessment kit*, Horizon's Regional Council, Palmerston North, N.Z. , FORMAK - The Forest Monitoring and Assessment Kit (Handford, et al 2004)

- Be able to be used generically and useful in a wide range of environments,
- Be practical and tangible (Harmsworth & Tipa 2006).

Together the SMARTA and Harmsworth and Tipa criteria acted as a check list in the consideration of appropriate tohu. In addition to these criteria, the research team felt that tohu should generally be recognisable by Māori groups throughout Aotearoa New Zealand, but flexible enough for tribal groups to modify them according to their own traditions, ways of knowing and local priorities. It was also felt that it would be helpful, though not imperative, if the tohu were relevant to international biodiversity agreements (e.g. UNEP 1992a; The Montréal Process Working Group 2015b) forest certification protocols (e.g. Forest Stewardship Council 1996), and national environmental monitoring initiatives (e.g. Ministry for the Environment 2011).

The Atua framework was used to help identify and locate cohorts of tohu, beginning with a selection of six tohu associated with Tangaroa. These were informed from other Tangaroa CBM tools that members of the research team were familiar with including freshwater (Tipa & Teirney 2003; Harmsworth *et al.* 2011) and estuarine environments (Walker 2009). Thirteen tohu relevant to Tāne were added to the framework drawing upon the same authors, as well as ideas generated from the work of Shortland (2011b) on indicators for kauri, and environmental indicators used in community-based monitoring of indigenous forests in New Zealand, for example bush shape and size (in Janssen 2004) and, canopy cover and condition (in Handford 2000). This process continued until a total of 35 tohu were identified each aligned to one of the seven domain Atua; Tangaroa, Tāne, Tāwhirimātea, Tū, Rongo, Haumie and Rūaumoko, plus one non-aligned tohu, Te Kuwhatawhata, this being an overall measure of cultural health of the forest being assessed.

At the first forest visit in January 2013, the research team confirmed a suite of 31, from the initial 35 tohu identified, for testing and development in the field. See Table 4 for this list of tohu grouped according to department Atua and sources from which they were inspired. The initial tohu, data collection form, guide and method comprised a prototype Ketewhaihua. The form simply listed the tohu, provided space for comments and a score (Likert 1 to 5) to rate its health. This prototype was tested twice at three forests (V1 Puketawai, V2 Te Maatu, V3 Moss Reserve, V4 Puketawai, V5 Moss Reserve, and V6 Te Maatu) between 26th of January 2013 and 24th of August 2013 under a continuous review process, in response to previous iterations to improve their efficiency and trustworthiness. Some tohu were dropped or merged with others, and new ones were added to the list and trialled before being accepted or rejected. The tohu, data collection form and method were

updated following forest visits to reflect new learnings over the course of fieldwork and associated hui.

Table 4: Initial list of tohu for testing grouped according to Atua and sources

TANGAROA	Tipa & Teirney,	Walker, 2009	Passl, 2004	Harmsworth et al., 2011	Shortland 2011	Janssen, 2004	Handford et al.,
1. Water clarity	√	√		√			
2. Water flow	√	√[80]		√			
3. Water quality	√			√			
4. Water fowl						√[81]	
5. Reptiles		√		√	√		
TĀNE MAHUTA							
6. Iconic bird						√[82]	
7. Honey eater					√	√[83]	√[84]
8. Fruit eater					√	√	√
9. Ground birds					√	√	√
10. Small birds						√	√
11. Bird pathways			√			√	√
12. Emergent trees					√	√	
13. Canopy trees					√	√	√
14. Climbing plants					√		
15. Understory or regeneration					√	√	√
16. Catchment vegetation	√	√		√			√[85]
17. Bush size and shape						√	√
TAWHIRIMATEA							
18. Smell of the forest		√		√			
19. Species on the edge							
TUMATAUENGA							
20. Tino rangatiratanga			√				
21. Kaitiakitanga			√				
22. Whanaungatanga			√				
23. Manaakitanga			√				
24. Recreation use			√				
25. Access	√	√		√			
RONGO MATĀNE							
26. Relationship with agriculture							√[86]
27. Rongoa/ medicinal plants		√	√	√			
HAUMIATIKETIKE							
28. Traditional mahinga kai	√	√	√	√			
29. Current mahinga kai	√	√	√	√			

[80] Walker (2009) refers to 'sound of water' rather than 'water flow'
[81] Janssen (2004) identifies Brown teal (*Anas aucklandia*) as an 'indicator species of habitat intactness'
[82] Janssen (2004) lists 'keystone species sustaining bush vitality' (footnote refers to indictors 6 to 10)
[83] Janssen (2004) lists 'indicator species of habitat intactness'
[84] Hanford et al (2004) outline two methodologies: a birdsong methodology and a 5-minute bird count
[85] Hanford et al (2004) refer to two related indicators 'nearby native forests' and 'corridors'
[86] Hanford et al (2004) refer to 'adjacent land use'

RUAUMOKO							
30. Erosion			√				
MAURI/WAIRUA							
31. Overall assessment	√	√		√			

A description of each of the forest visits undertaken in Round 1 follows, followed by a summary of methodological findings by the end of the round.

5.3.1 Puketawai (V1)

The first site visit to Puketawai (26/01/2013) involved all members of the core research team – Pat, John (JK), Maui, Ray and Dean. We engaged in existing tikanga practices in common usage amongst the team members including greetings in te reo Māori, hongi[87], karakia[88] and whanaungatanga or reconnecting with each other about whānau and tribal matters. Pat said he supported a strong focus on kawa and tikanga in this research and the team made a commitment to strengthen their knowledge of traditional practices associated with forest monitoring. The nga Atua kaitiaki framework was discussed including the use of it for resource management purposes. Although Maui and Ray were new to the framework, they were familiar with the domain Atua and traditional narratives around them. Pat explained the interconnectedness and holistic understanding of the Māori worldview through the framework and Dean said that they were useful in identifying tohu and gaps in the suite. We then went on a walk for about one hour, first stopping at Waiatua stream before climbing the hill passing through a small area of black beech forest until reaching a viewing point below the old pa site. Tohu were discussed on route. Both qualitative and quantitative data were collected for 31 tohu and notes made on four other possible tohu, recorded on data collection forms (including tohu, comments, Likert score 1 to 5) with a guide on the data collection method. We found the paperwork cumbersome and agreed that in the future the development of a phone app should be a priority. When we got back to the picnic table where we had started the day it was revealed that some had almost completed their forms while others had only just started their assessments. The ideal was seen as kaitiaki being in alignment with each other discussing the same tohu at the same time. All kaitiaki reported that they had difficulty identifying plants and discussed the need for more knowledge around native plant identification and traditional uses of these plants. They felt that flash cards or identification books would help. Dean said that the development of these was outside the scope of this research. In future rounds some team members bought their

[87] Hongi ≈ The formality of pressing noses in greeting
[88] Karakia ≈ Prayer, incantations

own books. An audio recorder was set up however road noise and the sounds of insects and nature were not conducive to clarity in recording.

Plate 2: Pat Park and Maui Duff discussing the use of the Atua Framework at Puketawai

5.3.2 Te Maatu (V2), Moss Reserve (V3)

Two forests were visited and assessed by the core research team on the same day; Te Maatu in the morning and Moss Reserve in the afternoon (16/03/2013). Short walks were taken at each of the forests prior to completing the forms as a collective. This helped to keep the kōrero focussed on the tohu being assessed. Some discussions were brief, particularly when the team members were in agreement, and others more robust. At times some kaitiaki worked ahead of discussions and others behind with the kōrero flipping back and forth, but overall the technique of having the walk first and completing the forms later kept the discussions more focussed. Changes to the Ketewhaihua from the previous version included:

- The form and guide were separate documents in the previous visit to Puketawai, however this was cumbersome so from here on in were combined into one document. Space on the forms was increased to allow for more detailed accounts on the health of tohu.

- Three new tohu were added to the original set: *Insect life* (after Janssen 2004; Shortland 2011b), *Pest plants/ animals* (after Janssen 2004; Shortland 2011b), and *Taonga* (after Walker 2009). *Waterfowl* was changed to *Water life* so as to include fish and instream invertebrates.

- Keywords or phrases were included around each tohu to help generate discussion and reach common understandings of the tohu and how to rate them.

- Adjectives were added to the Likert scale being descriptors along the 1 to 5 continuum. The trialling of a -2 to +2 semantic differential scale was discussed for the next site visit.

Team members felt their collective understanding of tohu was improving but the tohu still needed refining. In the visit to Puketawai the focus by kaitiaki was more on listing key species rather than on the health of species or specific tohu. In this visit all members included health kōrero, although not for all tohu. Sometimes the kōrero of kaitiaki was incongruous with their scores, for example for *erosion* Ray said that "there was none of any concern", however he scored it as a -2. The inclusion of whakataukī or pepeha[89] for each tohu to provide a link to the wisdom of the ancestors and help generate discussion around tohu was discussed and confirmed as a desirable outcome at a follow up hui (17/04/2013). It was also decided to invite other kaitiaki along in the next round of forest visits who were skilled in aspects of mātauranga Māori to assist.

5.3.3 Puketawai (V4)

The core research team were joined by invited guest, Ngārangi Marsh[90], for our second visit to Puketawai (3/08/2013). Ngārangi is well versed in te ao Māori and mātauranga Māori and was keen to share his knowledge. JK also bought some plant identification books along. There was a general buoyancy amongst the group as they had recently found out that Puketawai was to be returned to iwi as part of a Treaty of Waitangi settlement. Changes to the Ketewhaihua from the previous version included:

- A new tohu *Soils* was introduced to the suite for testing, as suggested by Dean's academic supervisors. The tohu *Access* was split into two; *Patekateka of Mahinga kai* and *Rua-te-pupuke of Access*. As it stood its meaning was ambiguous with confusion over whether it meant 'access to mahinga kai resources' or 'legal access to the site'. The team members felt that the number and range of tohu was appropriate at this stage but there was still a need to deepen their understanding of them.

- The introduction of poutiriao, whakataukī (or pepeha) and updating keywords or key phrases were discussed. Kaitiaki agreed that increased knowledge of these greatly increased their understanding of and the cultural relevance of tohu. Some poutiriao were known to the

[89] Pepeha ≈ Tribal saying or motto, figure of speech
[90] Te Aitanga-a-Hauiti

group, such as the aforementioned Tū-te-wehiwehi and Punga, so were aligned with relevant tohu and whakataukī. Ngārangi was able to give us the benefit of his expert knowledge and later provided poutiriao and whakataukī[91] for each of the tohu, where these had not already been identified. He stressed that these poutiriao and whakataukī were not necessarily linked to the Motueka area, and if the tool was to be utilised by other tribal groups, they would need to modify these to align with their own tribal narratives.

- A -2 to +2 semantic differential scale was trialled which better reflected the concepts of wairua and mauri, as a more culturally appropriate metric to the 1 to 5 Likert scale. Two kaitiaki said they preferred the new metric, and the other two said that they were undecided but would like to keep trialling it.

- A space for recommendations was added to the data collection form, so that kaitiaki could provide a summary of the assessment and potential advice to forest-holders. Maui's recommendation was aimed at the Department of Conservation acknowledging that Puketawai was being returned to iwi referring to "tino rangatiratanga" and that he was looking forward to it. John addressed his recommendation to 'to who it may concern' stating that he wanted to work together to see their taonga Puketawai back in a natural and healthy state. The others did not make recommendations.

5.3.4 Moss Reserve (V5), Te Maatu (V6)

Three guest kaitiaki, Ngārangi Marsh, Ngawaina (Joy) Shorrock, and Melz McColgan[92], spent the day with the core research team at Moss Reserve in the morning and Te Maatu in the afternoon (24/08/2013). The core research team members are all male. We felt that the approach needed to be assessed from female perspectives as well. Joy holds mātauranga Māori around rongoā[93] and traditional use of natural resources. Melz's knowledge is more specific to waterways. All three guests provided cultural and technical advice to the research and reported back on the appropriateness of the tohu and the workability of the Ketewhaihua. Melz completed a data collection form at both sites and Joy completed a form at Te Maatu. The primary change to the Ketewhaihua from the previous version was the inclusion of relevant poutiriao and whakataukī that had been matched to each tohu by Ngārangi following the previous forest visit.

[91] The primary source material for many of the whakataukī supplied by Ngārangi was
Mead, H.M. & Grove, N. 2004, *Nga Pepeha a nga Tipuna; The Sayings of the Ancestors*, Victoria University Press, Wellington, N.Z.
[92] Melz was accompanied by her daughter Ruby
[93] Rongoā ≈ Medicinal plants, traditional and alternative medicine

There was ongoing confusion over the *Rua-te-pupuke of access* tohu. Some kaitiaki scored it on the ease of access to the site while others scored it on legal access to harvest forest products. We decided to change its description to '*harvest rights'* to clarify the meaning. There was also continuing confusion over *Tahu of traditional mahinga kai levels* and *Patekateka of current mahinga kai levels*. It was agreed that these tohu should be combined into one (*Patekateka of mahinga kai levels*), including the adjectives 'little', 'some', and 'traditional levels' along the -2 to +2 sematic differential scale to improve collective understanding of the tohu.

The research team felt that the number and range of tohu were appropriate, and that the Ketewhaihua was well developed however, they also felt there was still plenty of collective learning required. Maui said he was "still getting (his) head around whakataukī" due to their esoteric nature. There was continuing discussion about including *Hineone of soil condition, Poutini of taonga* and *Te Kuwhatawhata* under the realm of Papa, but it was then decided to leave them the way they were. The inclusion of an *economic* tohu (i.e. the ability of the forest to pay for its own management) was discussed. This did not gain unanimous agreement amongst the kaitiaki, however the team felt it was worth trialling. Ngārangi said that he would research an appropriate poutiriao and relevant whakataukī.

5.3.5 Summary – Round 1

In Round 1 (forest visits V1 to V6) the core research team was accompanied on occasions by invited guests, undertook assessments of forest health at three local forests (Puketawai, Te Maatu and Moss Reserve) local to the township of Motueka with kaitiaki all being residents and having personal and tribal connections to the forests. On Plate 3 below core team members are photographed with guest kaitiaki at Moss Reserve. This round was dedicated to the confirmation of a suite of workable tohu and the development of a functioning prototype Ketewhaihua (culturally-based monitoring tool kit).

By the completion of Round 1 (Forest visits V1 to V6) each tohu was aligned to a poutiriao within the framework and key words or phrases. Poutiriao have more specific roles and relationships associated with particular species or group of species, minerals or environmental phenomena. Relevant whakataukī were also identified for each tohu. These served to increase the cultural relevance of the tohu, create a connection between current kaitiaki and their kaitiaki ancestors and stimulate

discussion in the field. Traditional narratives, such as waiata[94], karakia[95], pūrākau[96], mōteatea[97], whakataukī, and whakatau-ā kī[98], were considered as culturally appropriate methods for distilling the essence of health of tohu and recording qualitative data. After reflecting on progress following V3, experts, particularly of tikanga, culturally-based monitoring, water management, rongoā and traditional uses of forest products, were included for site visits V4[99], V5[100] and V6[101]. They were able to provide cultural and technical advice and act as 'peer debriefers' of the research.

Plate 3: Research team members and guests at Moss Reserve. L-R Melz McColgan, John Katene, Maui Duff, Ray Anderson, Ngārangi Marsh (partly obscured), and Pat Park

Different types of scales were discussed for measuring the health of tohu quantitatively, with a short paper produced by the principal researcher covering the two most common metrics used in CBM in New Zealand today – a 1 to 5 Likert scale (after Harmsworth 2002a; Tipa & Teirney 2003; Walker 2009) and a -2 to +2 semantic differential scale (after Morgan 2007b). These two 'measuring sticks' were tested in the field. In the first three forest visits (V1 to V3) the 1 to 5 Likert metric was trialled. From V4 onwards a -2 to +2 semantic differential scale was trialled, similar to the scale adopted by Morgan's mauri-ometer (Morgan 2004,2007a) but with the addition of variable semantic adjectives to assist the discussion and the kaitiaki in decision making between points. For example, Rurutangiakau, the adjectives across the scale from -2 to +2 are 'none seen, a little seen, and much

[94] Waiata ≈ Song or chant
[95] Karakia ≈ Incantations, prayer
[96] Pūrākau ≈ Traditional narrative, or erroneously "myth or legend"
[97] Mōteatea ≈ Traditional poetic chants, dirges and laments
[98] Whakatau-ā-kī (as distinct from whakataukī) are proverbs or sayings for which the original speaker is known.
[99] Ngārangi Marsh (Te Aitanga-a-Hauiti)
[100] Ngārangi Marsh, Ngawaina Joy Shorrock (Te Ātiawa), Melz McColgan (Tiakina te Taiao)
[101] Ngārangi Marsh, Ngawaina Joy Shorrock, Melz McColgan

seen'. By V5 all kaitiaki preferred the latter scale. It was easier for them to visualise the centre of the scale and a barometer better reflected the enhancing − diminishing aspects both mauri and wairua.

By the end of Round 1 the prototype Ketewhaihua including the framework, the tohu and the method had been well-developed, tested and was functioning well.

5.4 Final set of tohu

A final suite of tohu including their relevant domain Atua, poutiriao, tohu, key words and whakataukī are presented in version 8 of the Tohu Ngahere Data Collection Form (Appendix 2 for full details). A brief commentary on their development according to domain Atua follows.

Tangaroa. Three of the research team members had previous experience with other CBM tools involving freshwater (e.g. Passl & Walker 2005; Tipa & Teirney 2006b; Harmsworth *et al.* 2011), so the Tangaroa set of tohu were familiar to them as was their calibration, i.e. kaitiaki easily reached relative consensus of their understanding of these tohu and how to rate them. *Tūtewehiwehi of reptiles* had previously been included in tohu associated with Tāne (e.g. Walker 2009), however he and *Punga of insects* are both progeny of Tangaroa (Moorfield 2011) so it was felt to be best included in this set.

Tāne holds the bulk of the tohu as the assessment is within his domain. The original Tāne set of tohu were primarily informed by the FORMAK kit (Handford *et al.* 2004), the Bush Vitality Kit (Janssen 2004), and Indicators for Kauri Ngahere (Shortland 2011b), although some of the other work that the research team has been involved in, such as Walker (2009) and Harmsworth *et al.* (2011) also contain Tāne tohu. The main issue with this set of tohu was to do with a lack of plant identification skills amongst the kaitiaki and knowledge around their traditional uses. This was resolved in part by members bringing along identification texts during fieldwork. This was much less of a problem when expert kaitiaki were involved or forest-holders were present because of the knowledge that these people had to share.

Shortland (2011b) lists kākāriki (*Cyanoramphus* species), kiwi (*Apteryx* species), tūī (*Prosthemadera novaeseelandiae*), kākā (*Nestor meridionalis*) and kererū (*Hemiphaga novaeseelandiae*) as possible bird indicator species in kauri forests. The Bush Vitality Kit focuses on 14 keystone species. The tohu *forest kaitiaki* recognises that most forests will have an iconic species that the forest-holder will identify with. In terms of other bird species the FORMAK kit utilises standard 5-minute bird counts where observers note all birds heard and seen. In the Ketewhaihua birds are grouped according to type (e.g. *nectar feeders, fruit eaters, ground birds, small birds*) in part for reasons of brevity and in

part because under whakapapa taxonomy poutiriao are usually responsible for groups of species rather than individual species. Bird numbers are not assessed in 5-minute intervals but rather over the entire duration of the assessment with score related to relative numbers. For example, five kākā seen in a forest over a day may attract a mean score of +1.5, while five bellbirds would probably attract a score closer to 0 given their relative commonness. The *Hurumanu of bird pathways* tohu is similar to connectivity tohu used by Handford *et al.* (2004) and Janssen (2004) in their monitoring kits, however the term bird pathways feature in local restoration and cultural values conversations (e.g. Walker & Bunt 2010) so were considered to be a more appropriate tohu.

In their forest assessment kits both Handford *et al.* (2004) and Janssen (2004) group trees in terms of emergent trees, canopy trees and understory. Trees are also grouped within the Ketewhaihua along the same lines, with the addition of *Rerenoa of climbing plants.* Climbing plants, such as the mistletoes (*Peraxilla* species), are sensitive to possum (*Trichosurus Vulpecula*) browse so are a particularly useful indicator in beech forests. *Tanga-i-waho of catchment vegetation* is a tohu familiar to research team members and included in other CBM tools (Passl & Walker 2005; Tipa & Teirney 2006b; Walker 2009; Harmsworth *et al.* 2011) so was included in the Tāne set of tohu. The tohu also resonates with 'nearby native forests' and 'corridor' tohu (from Handford *et al.* 2004). *Te Wao-tu-rangi of bush shape and size* was included as a tohu after Handford *et al.* (2004) and Janssen (2004) where small narrow forests are rated low and large wide forests rated high in their respective forest assessment kits. This approach was utilised in the Ketewhaihua. The conversations about bush shape and size also helped the research team gain a 'minds-eye' view of the forest in the absence of maps. From the initial set of Tāne tohu all were confirmed, with just one being added, that of *Maiki-roa of pests and weeds*. The tohu presented difficulty for the team to rate at times because the definition of pests and weeds can vary. As examples, pigs and blackberry[102] can be viewed as undesirable if they are negatively affecting forest health, but can also be seen as culturally desirable if they are treated as a food resource. However, the tohu was retained because it was felt necessary to have these conversations even it was difficult to rate at times.

Tāwhirimātea. Under the umbrella of Tāwhirimātea, other CBM toolkits contain *Piro* tohu (e.g. Passl & Walker 2005; Walker 2009; Harmsworth *et al.* 2011). The tohu engages a sense that is rarely engaged in monitoring, though particularly obvious in healthy beech forests for example, with the fragrance of honeydew. The tohu *Tānerore of climate* was initially described as *species on the edge of its existence* but was later renamed. The tohu relates to climate

[102] *Rubus fruticosus*

change, in particular on species that exist along climatic limits and how climate change may affect their distribution. 'Mauri' trees were planted at four study sites, the species being maire rauriki (*Nestegis lanceolata*)[103] (Plate 4 John Katene planting maire rauriki tree at Moss Reserve). The Motueka Valley lies within the southern limit of maire rauriki. The trees planted will act as a focal point for future visits for the purpose of ceremony, provide a connection to previous visits by kaitiaki and help illuminate discussions around climate change in light of the species current distribution.

Tūmatauenga The tohu *tino rangatiratanga, kaitiakitanga, whanaungatanga*, m*anaakitanga* and *recreation use* are cultural values regularly cited in cultural impact assessments and cultural values reports relevant to the iwi groups involved in the research (e.g. Walker & Bunt 2006; Walker & Bunt 2010) and were adopted as tohu of cultural health here under the umbrella of Tūmatauenga. Two new tohu were introduced to the list, these being *Tū-ringa-raupa of economic return* and *Poutini of taonga*. *Tū-ringa-raupa* was the last tohu introduced prior to V7 after conversation around the ability of the forest-holders to undertake restoration activities and funding required to do so. By the end of the fieldwork kaitiaki were still having some difficulty with how to rate the tohu, but agreed that some important discussions had taken place around the economics of forest management and restoration activities.

Access was included as a tohu amongst the initial suite of tohu based on the Site status – Accessibility indicator from Tipa and Teirney (2006b), particularly in relation to legal access. This tohu did not make the final suite of tohu. It was difficult to score in light of the fact that the first three forests were open to the public and with the last three forest access was readily gained from the forest-holders. Besides, the other and more important aspect of the tohu was access to mahinga kai. This was clarified under a new tohu *Rua-te-pupuke* under the umbrella of Haumie.

Rongomātāne The tohu 'relationship with agriculture' was renamed *Wainui of adjacent land-use* after Handford *et al.* (2004) in recognition that land-uses other than agriculture, such as exotic forests and settlements, often adjoin indigenous forests. Difficulties were experienced by kaitiaki in rating the health of *Uepoto of rongoa*. While collectively the group knew a reasonable amount about rongoa and could identify some species, making judgement about the quality and sustainable levels of harvest was outside of their expertise. The tohu was retained because it was felt that over time the collective knowledge would build and increase the utility and effectiveness of the tohu.

[103] Also known as white maire

Haumietiketike. Mahinga kai is a tohu commonly used in CBM tools in Aotearoa New Zealand (e.g. Tipa & Teirney 2006b; Walker 2009; Harmsworth *et al.* 2011), although curiously Shortland (2011b) does not refer to mahinga kai in the work on cultural indicators for kauri forests. Initially mahinga kai was split into two tohu these being 'traditional levels of mahinga kai' and 'current levels of mahinga kai'. However, kaitiaki experienced difficulty with the method mainly to do with judging what traditional levels were like. They unanimously felt that levels were higher in the past but placing these levels on a scale was difficult. This was resolved by combining the two tohu into *Tahu of mahinga kai levels* with 'traditional levels' located as an adjective on the semantic differential scale between 1 and 2. *Rua-te-pupuke of harvest rights* was added after the 'access' tohu under Tūmatauenga was discontinued. This clarified the meaning of the tohu which concerned the right of Māori to access the forest and harvest materials (mahinga kai).

Rūaumoko. Prior to a report on Māori cultural values on the Motueka River when concerns were expressed about erosion (Walker & Bunt 2010), Rūaumoko was not considered to be an important Atua in respect of CBM in the catchment or the wider rohe[104] of the iwi groups involved. His relevance was confirmed by the 2010 – 2011 Canterbury Earthquakes. He forms part of the Atua framework described in the previous chapter and *Ruaroa of erosion* to the list of tohu. *Hine-one of soils* was included as an accompanying tohu, as suggested by the principal researcher's academic supervisors and confirmed by the kaitiaki on the research team.

Mauri – Wairua. The only tohu that does not come under the umbrella of any of the seven domain Atua is *Te Kuwhatawhata* sometimes referred to as *'feeling in the puku[105]'.* This tohu is an overall assessment of forest health and is a familiar tohu to team members who have worked on other CBM projects in their rohe (e.g. Passl & Walker 2005; Walker 2009; Harmsworth *et al.* 2011).

In summary, of the 31 initial tohu that were identified through the literature review and confirmed by the research team as suitable candidates for testing, 26 of these were tested and remained unchanged; two were tested and discontinued (Access and traditional levels of mahinga kai); three were retained after modifications (4. *Moetahuna of water life*, 8. *Parauri of nectar feeders*, 30. *Tahu of mahinga kai*); five new tohu were added to the final suite, tested and confirmed (5. *Punga of insects*, 19. *Maika-roa of pests and weeds*, 26. *Tū-ringa-raupa of economic return*, 31. *Rua-te-pupuke*

[104] Rohe ≈ Tribal territory or district
[105] Puku ≈ Belly, stomach

of harvest rights, and 33. *Hine-one of soils*); and one (*Poutini of taonga*) was added, tested and discontinued.

Plate 4: John Katene planting a maire rauriki tree at Moss Reserve

5.5 Forest assessments using the fully developed Ketewhaihua – Round 2

Following Round 1 (V1 to V6) the research team considered the prototype Ketewhaihua to be functioning well, and the suite of tohu were appropriate and sufficient to carry assessments on the health of indigenous forests, at least forests that kaitiaki had a cultural relationship with. In Round 2, three forests were chosen for study which were less familiar to kaitiaki than those close to their home township of Motueka. Kākā Hill (V7), Te Kāinga Tawhai (V8) and Brewerton's Forest (V9) are 'hinterland' forests located in the upper Motueka catchment. Here we sought to test the transferability of the Ketewhaihua across forest types, forest size, forest holder aspirations and management regimes.

Using the fully developed Ketewhaihua forest assessments were undertaken at the three forests, from 26th of September 2013 to 10th of November 2013. Pat and Ray were unable to participate in this round. The assessments were undertaken by the other core team members, plus an invited guest kaitiaki for each visit. The invited guests were familiar with other CBM tools but not the Ketewhaihua. They were able to act as 'peer debriefers' and provide advice to the group on the durability and transferability of the tool across individuals who had not been involved in the development of the tool.

It was acknowledged by the research team that much knowledge is contained in the experiences of those people who are intimately connected to these forests, these being the forest-holders, the holders of rights, roles and responsibilities over the forests. A methodological change was required because of this lack of familiarity of these forests by the kaitiaki, unknown in Round 1. The assessments involved kaitiaki undertaking semi-structured interviews of the forest-holders using the data collection form as a guide working through each tohu one at a time. Each kaitiaki completed their own data collection form. The final part of the data collection form involved kaitiaki highlighting their highest scored tohu, from which to make commendations to the forest owners on the state of health of their forests, and their lowest scored tohu from which to make recommendations on interventions to improve forest health.

As in Round 1, the quantitative data was collated in a spreadsheet with the mean scores and qualitative data summarised for each tohu in field reports. In addition, a Box-and-Whisker plot was utilised to display and analyse the distribution of the quantitative data for the three forests. Box-and-Whisker Plot are a standardised way of displaying the distribution of a data set. This method organises the data according to a five number summary (minimum, lower quartile (Q1), median, upper quartile (Q3), and maximum (Dodge 2008). The method was chosen because it was useful for comparing the three forests across a large number of observations.

By the time of the Kākā Hill visit (V7), the prototype Ketewhaihua was well developed with each tohu aligned with (i) an appropriate poutiriao, (ii) keywords or phrases, (iii) whakataukī and sometimes (iv) related species or phenomenon. From V7 onwards, few changes were made to the Ketewhaihua. Summaries of improving the utility and effectiveness of the Ketewhaihua and tohu at the three forests follow. Results of these forest visits are in Chapter 5.

5.5.1 Kākā Hill (V7)

Hori Kahukura was seconded into the research team in the place of Pat and Ray for our visit to Kākā Hill (26/09/2013). Hori had not worked on this project, however he had previously undertaken freshwater monitoring and research using CBM tools in the Motueka – Riwaka catchment. Kākā Hill was the first forest where interviews of forest-holders were undertaken. The kaitiaki interviewed Dean as he is one of the forest-holders at Kākā Hill. The changes recommended in the last forest visit were updated and included in the latest version of the Ketewhaihua, including the introduction of *Tū-ringa-raupa of economic return*. It appears that combining *Tahu* and *Patekateka* into a single tohu with 'traditional' levels on the scale has eliminated the confusion which afflicted the separate tohu,

with the low and high scores now ranging between 0 and 1 (i.e. there is high consensus between the kaitiaki on how to rate traditional levels of mahinga kai on the revised tohu).

Following changes recommended in the previous round of fieldwork there was a general rise in satisfaction with the appropriateness of the current suite of tohu, with no changes either to the tohu or to the format of the Ketewhaihua. Of the current suite of tohu, Maui said that he found the tohu much easier to use now, “Tika ki te ao Māori”. JK reported that, “They look good, we are improving all the time”. Hori found the Ketewhaihua easy to understand and felt that the tohu were appropriate and the range was comprehensive.

5.5.2 Te Kāinga Tawhai (V8)

Daren Horne[106] was seconded into the visit to Te Kāinga Tawhai (12/10/2013). Daren had not worked on this project, however he had previously undertaken freshwater and estuarine monitoring using CBM tools in the Motueka – Riwaka catchment. Daren was accompanied by his son Dallas. Scott Nicol and Maria Deutsch are the forest-holders at Te Kāinga Tawhai (Plate 5 – Maria is not present as she took the photograph). After our usual walk through the forest and inspection of Clarke Stream we discussed with them the health of their forest. Their knowledge and guardianship of their forest was greatly appreciated by the team.

[106] Daren was accompanied by his son Dallas

Plate 5: (L to R) Dean Walker (Principal researcher), Daren Horne (invited guest), Scott Nicol (forest holder), Maui Duff and John Katene. Daren's son, Dallas, is in front of Daren.

Comments about the tohu were again mainly positive. Maui said that the "Tohu are appropriate – easily understood and used". JK said for him that the Ketewhaihua just gets better the more it is used. *Poutini of taonga* was removed from the final suite of tohu after it continued to be found difficult to quantify, the team reiterated that 'all things are taonga', and that the health of taonga were already discussed and rated under other tohu.

5.5.3 Brewerton's Forest (V9) – 10 November 2013

Hori Kahukura returned for the final forest visit to Brewerton's Forest (10/11/2013). Along with JK and Maui, the team was joined by Andrew Karalus, the estate value manager for Nelson Forests Ltd. Haley Leslie-Bole an environmental anthropology student from Colorado College USA was also present as an observer. Andrew was interviewed, observations made and data recorded. While Andrew had some familiarity and knowledge about the forest, this was at a lower level than we had experienced of the previous two interviews of forest-holders. The group initially visited three sites in the forest. Later we drove down a forestry track and visited a fourth site at a ford where an unnamed stream was crossed. This site was outside of the indigenous forest area but runs through it, then through *pinus radiata* plantation before reaching the ford.

By the final forest visit kaitiaki generally felt that the range of tohu and the associated poutiriao and whakataukī were appropriate and 'te Ao' (the whole environment) well-covered. Maui reported that

“The whakataukī are very much appropriate and relevant, and relevant Atua are acknowledged”. Hori felt that there were possibly too many tohu, but made no suggestions of which ones to drop. There was some confusion on how to score *Tū-ringa-raupa of economic return*. To assist clarification, it was decided to introduce the term ‘breaking even’ to replace ‘moderate’ as a cue word (value = 0) in the final version of the Tohu Ngahere Data Collection Form (Appendix 2).

Haley had to be back in Nelson by mid-afternoon and Dean had to leave early with the kaitiaki completing the data collection sheets. The forms were picked up a week later. What was noticeable was that the data collection forms were more thoroughly completed than for any other forest visit. A point of learning was that if kaitiaki had time to reflect on their day over the next few days then they added more information from their reflections.

5.6 Methodological challenges

Over the research period there was a number of methodological challenges. These can be categorised according to tohu development, species identification, data collection sheet and method, whanaungatanga, and timing.

5.6.1 Tohu development

Between 31 and 35 tohu were trialled at six forest sites during 2013, as described. During Round 1 forest visits (V1 to V6) the following issues arose (i) Kaitiaki not scoring some tohu, (ii) Kaitiaki not describing the health of some tohu, (iii) Incongruity between a kaitiaki’s description of the health of a particular tohu and the score given, and (iv) Kaitiaki not identifying species associated with the tohu. Reasons identified by kaitiaki for these issues included (i) forgetting to document qualitative or quantitative data on the form, or not getting around to it, (ii) feeling that the tohu was not possible to score or was inappropriate to reduce it to a number, (iii) differences in understanding of a some tohu or how to score them, (iv) ambiguity in the descriptions of particular tohu.

From V4 onwards incidents of kaitiaki not scoring tohu ceased and incidents of not making comment on the health of tohu became increasingly infrequent, as they became more familiar with the tool. When new kaitiaki were introduced to the Ketewhaihua these issues were not apparent, probably because of the assistance they had from core team members. Instances where quantitative scores made by kaitiaki were not consistent with what they said were readily identified through cross-checking data types. Adjustments made in subsequent rounds to improve consensus and understanding amongst kaitiaki. Following each forest visit tohu were either modified, confirmed or rejected, based on learnings from that visit.

5.6.2 Species identification

Some kaitiaki had difficulty with plant species identification along with levels of mātauranga Māori around traditional uses of plants and animals, although between them there was a reasonable level of collective knowledge. There was a call for a guide to be developed to assist but this was outside the scope of this research. The issue was partly resolved, initially by team members bringing along relevant texts, and later inviting expert kaitiaki who had in-depth knowledge in this area (V4 – V6). In Round 2 (V7 – V9) forest-holders were interviewed which tapped into a good level of place-based knowledge. These people were familiar with species in their forests which they were able to share. By this stage, kaitiaki had improved their knowledge of traditional uses of plants and animals which they could also share.

5.6.3 Data collection sheet and method

In the first forest visits (V1 – V3) the data collection sheet and the guide to its use (the method) were 2 separate documents. This was found to be cumbersome. By V4 the data collection sheet and method were combined into a single document. Further format changes were made to the document, e.g., the creation of more space for recording qualitative data, and the inclusion of space for commendations and recommendations at the end of the sheet. By the end of Round 1 (V6) all format issues had been resolved. At the beginning of the research it was acknowledged by the core team that the future of data collection would be using a phone app or similar, however the development of such an app was outside the scope of this research.

5.6.4 Absenteeism

In the first round of forest visits (V1 to V6) the same four mandated kaitiaki (the core research team) participated in all six forest visits, sometimes accompanied by whānau members and 'expert' kaitiaki. In the second round (V7 to V9), two of the core team had other commitments which meant that they were unable to participate in the fieldwork. Instead, for the three forest visits they seconded an associate to undertake their responsibilities in their absence. These substitute kaitiaki were manawhenua and had experience with culturally-based monitoring in the Motueka – Riwaka catchment, but not with this project. The core team members saw this as an ideal opportunity for new team members to share in the learning experience and the substitute kaitiaki were keen to be part of the learning. Effect was given to the kaupapa Māori principle of whānau and the importance of sharing knowledge with other whānau kaitiaki. It would have been preferable to start with a larger team to accommodate problems of absenteeism and increase the rigour of the research however, financial constraints did not allow this. The approach did allow for the transfer of knowledge about

the Ketewhaihua to a greater number of kaitiaki and whānau which was culturally important to the team.

5.6.5 Timing of assessments

Traditionally the assessment or monitoring of forest health was associated with the harvest of birds or some other seasonal or forest event. For example, kererū (*Hemiphaga novaeseelandiae*) feed on the berries of some podocarp species. Experts would evaluate berry volumes through early autumn to provide insights into bird numbers and expected quality, with kererū harvest mainly taking place during May and June. Maramataka[107] was an important mechanism used by tribes to inform the timing of such activities. The months and phases of the moon guided forest monitoring and harvest with named days of the month being more favourable than others. Fieldwork was undertaken within the constraints of the budget and research timeframe rather than aligned with traditional monitoring events which would have been preferable. It would also have been preferable to trial the Ketewhaihua over more than one year with multiple visits to each forest, to better test its monitoring capability and increase its rigour however, once again the project was constrained by budget and research timeframes.

5.7 Evaluation of our research practice

A convergent kaupapa Māori - action research evaluation methodology was presented in Chapter 3, Theoretical framework, Section 3.5. This brought together five evaluation criteria from the IBRLA framework initially developed by Bishop (1996) for kaupapa Māori (1 to 5 below) and four offered by Lincoln and Guba (1985) for action research (6 to 9). A brief description of our research practice against those nine evaluation criteria follows.

1. Initiation: The idea behind this research was first mooted at an iwi environmental indicators hui at Te Āwhina Marae in July 2008. The hui was attended by local kaitiaki as part of the Motueka ICM programme who all felt that the development of a toolkit for monitoring the health of ngahere was a good step to make. In 2010, the discussion was followed up with the principal researcher approaching mana whenua ki Motueka seeking their involvement in the co-creation of a culturally-based tool for monitoring the health of indigenous forests. Four iwi groups supported the project with Te Ātiawa, Ngāti Tama and Ngāti Kuia mandating kaitiaki as co-researchers.

2. Beneficiaries: The project empowered kaitiaki in their practice of kaitiakitanga and involved them in ako learning experiences. The three tribes and the people who participated in the research are the

[107] Maramataka ≈ Traditional almanac or calendar used to guide planting, harvesting and fishing

primary beneficiaries of this project. The research outcomes will support wider kaitiakitanga Māori aspirations. The tool will be freely available for any Māori group working in the NRM space in Aotearoa New Zealand to make use of or adapt for their own cultural and contextual reality. Wider New Zealand society is also a potential beneficiary through potential environmental and cultural gains. Other Indigenous peoples may also benefit from the learnings.

3. Representation: Kaitiaki on the research team undertook the work with the support of their iwi and hapū. Expert kaitiaki and other whānau were involved in the project and the voices of others were brought back to the table by the core kaitiaki through wider conversations in the community.

4. Legitimacy: The research was viewed by kaitiaki as an expression of tino rangatiratanga. It was a positive reflection of the Treaty of Waitangi principles of partnership, participation and protection. One kaitiaki said that the research from his perspective was an expression of tino rangatiratanga and spoke of "*Me whakamana i ngā mea Māori*" – this being about legitimising and revitalising Māori ways of knowing and being. Qualitative data was gathered using an Atua framework, culturally-based tohu and a culturally-appropriate metric.

5. Accountability: The research approach has its foundation in Māori epistemology and is undertaken in kaupapa Māori ways. It builds upon a traditional cosmology with ultimate accountability laying with nga Atua Kaitiaki. Formal issues of accountability are contained in MoAs with each of the tribal groups. Parties to the project retain rights over knowledge that they brought to the project. Any new intellectual property that has been created is jointly held by the developing parties.

6. Credibility: The research team has confidence in the 'truth' of the findings. This was confirmed at two hui, the first involved a hui of core team members, the second included wider whānau. Regular checks with the core kaitiaki were made throughout the project through formal feedback forms, hui and informal conversations. Guest kaitiaki were involved in three forest visits (V4, V5 and V6), to provide expert knowledge, insights and direction to the research team. Effect was given to the kaupapa Māori principle of whānau and the importance of sharing knowledge with other whānau kaitiaki. They also acted as 'peer debriefers' where they participated in, reviewed and asked questions about the research. This added a layer of credibility and trustworthiness to the research.

7. Transferability: The research team felt that the findings of the research could be transferred to other forests and other contexts. The Ketewhaihua was tested in six forests, of a range of forest types and under the management of a range of forest-holders. It proved to be a useful tool in a range of different contexts in the Motueka so there is no reason to doubt that it would have utility in

other catchments. The tool was designed to be easily modified by other tribal groups to suit their cultural reality and relationship to place. To confirm its transferability across tribes, this would need to be made by other tribal groups applying the tool in their own contexts.

8. Dependability: Data collection forms, feedback forms, hui and field reports form an audit trail for this research. Triangulation was undertaken to compare qualitative (what kaitiaki said about the health of tohu) with quantitative data (how they scored the health of tohu). Where the kōrero and scores were inconsistent, changes were made to tohu over learning spirals in order to improve, confirm or reject tested tohu.

To enhance the dependability of the research kaitiaki formally mapped their individual and collective learning spirals using feedback forms. The team was activity reflexive across seven areas of inquiry, documented following fieldwork, these being: (i) Tikanga; (ii) Tohu; (iii) Data collection; (iv) Māori cultural values; (v) Diversity; (vi) Principal researcher's performance; (v) Kaitiaki's personal performance. Summaries of these reflections were documented following fieldwork in field reports for circulation and discussion. Feedback forms were updated following learnings from previous fieldwork (Appendix 3 for version 7 as an example).

9. Confirmability: In this project the researchers are hardly neutral. Kaitiaki bring to the research team aspirations of their manawhenua iwi. They also bring their own personalities, bias, motivations, interests, experience and professional roles. Subjectivity accompanied by open kōrero, is normative in terms of methodology and practice. Rather than seek objectivity or neutrality on the part of the researchers, in this methodology personalities are encouraged, and open discussions are had. It is important that, a range of views are represented in a team and to identify issues to be addressed. If one individual has strong views matched by accompanying outlier scores, this is invariably balanced by the kōrero and scores of the other kaitiaki.

5.8 Summary

Three members of the research team were familiar with an Atua framework, having used it for resource management purposes including CBM. This framework was further developed with the results outlined in Chapter 5, Section 5.2. The redeveloped Atua framework was used to help identify and structure an initial set of 31 tohu into a prototype toolkit along with an appropriate data collection method and data collection sheet. Tohu were then iteratively tested, and refined, confirm or rejected by the research team at three 'local' forests, which all kaitiaki on the team had a strong connection with. By the end of this round of research, 35 tohu had been confirmed and the Ketewhaihua was working well (Chapter 5, Section 5.3). A brief commentary on the development of

the final suite of tohu including their relevant domain Atua, poutiriao, tohu, key words and whakataukī is made in Chapter 5, Section 5.4.

The next step was to test these tohu at three 'hinterland' forests using the fully-developed Ketewhaihua (Chapter 5, Section 5.5). This round included interviews of the forest-holders and allowed for the testing of the transferability of the tool with (i) forests unfamiliar to the kaitiaki, (ii) other forest types, and (iii) by kaitiaki who had not been involved in this research to date. A comparison of the relative health of the three forests was made by focussing on the highest and lowest scored tohu so as to make commendations and recommendations to the forest-holders.

The research challenges in the development of the Ketewhaihua are then outlined, grouped according to tohu development, species identification, data collection sheet and method, absenteeism and timing of assessments (Chapter 5, Section 5.6). The final part of this chapter is a reflexive evaluation of the team's research practice (Chapter 5, Section 5.7). The evaluation was carried out using the convergent kaupapa Māori - action evaluation methodology outlined in Chapter 3, Section 3.5.

In the next chapter, results of the application of the fully developed Ketewhaihua to the three hinterland forests and the key findings from those assessments are presented across the full suite of tohu grouped by domain Atua.

Chapter 6

Application of the Ketewhaihua to three forests in the upper Motueka catchment

6.1 Introduction

The previous chapter outlined the methodology involved in this research to develop a suite of 'fit for purpose' tohu and a prototype Ketewhaihua for assessing the cultural health of indigenous forests and in the process answer the research questions. By the Kākā Hill visit (V7), the Ketewhaihua was a fully functioning prototype with most of the early development issues resolved. Forest assessments were undertaken by two members of the core research team (John Katene and Maui Duff), plus an additional guest kaitiaki (Hori Kahukura V7 and V9, and Daren Horne V8), facilitated by the principal researcher. At each forest introductions were made, a walk was undertaken with the forest-holders and the research team, observations were made, and discussions took place. Interviews with the forest-holders were carried out using the data collection form as a semi-structured interview. The health status of each tohu was recorded by each kaitiaki, firstly as qualitative data in the form of distillations of observations and the discussion which took place, and secondly as quantitative data with each tohu also being rated on a -2 to +2 semantic differential scale to attain an overall picture of the health of each forest.

In this chapter the results of the three forest assessments (Kākā Hill (V7), Te Kāinga Tawhai (V8) and Brewerton's forest (V9)), are presented across the suite of tohu grouped by Atua. The introduction of each Atua is followed by a chart showing the mean kaitiaki scores for all of the tohu within the domain of that Atua for each of the forests. This is followed by a brief statement on the highlights/ findings for each tohu, each supported by a table containing representative qualitative comments and mean scores made by members of the research team. The chapter is concluded with a summary of the results by Atua using a Box-and-Whisker Plot, to compare the distribution of the data across the three forests, followed by a section on the key findings.

6.2 Tangaroa

Tangaroa is the Atua of oceans and inland waterways. Below is a summary of the quantitative data (Figure 9) and qualitative data (Tables 5 to 10) collected at the three study forests for the six tohu that were developed, tested and validated within his domain. The state of health for all three forests was reasonable, for the most part attaining positive responses. Parawhenua at Te Kaainga Tawhai

achieved the maximum score with all kaitiaki rating the tohu +2. The obvious exception was Tū-te-wehiwehi, which had less to do with the state of health of reptiles in the forests but more a reflection of lack of knowledge of their health status on the part of the forest-holders.

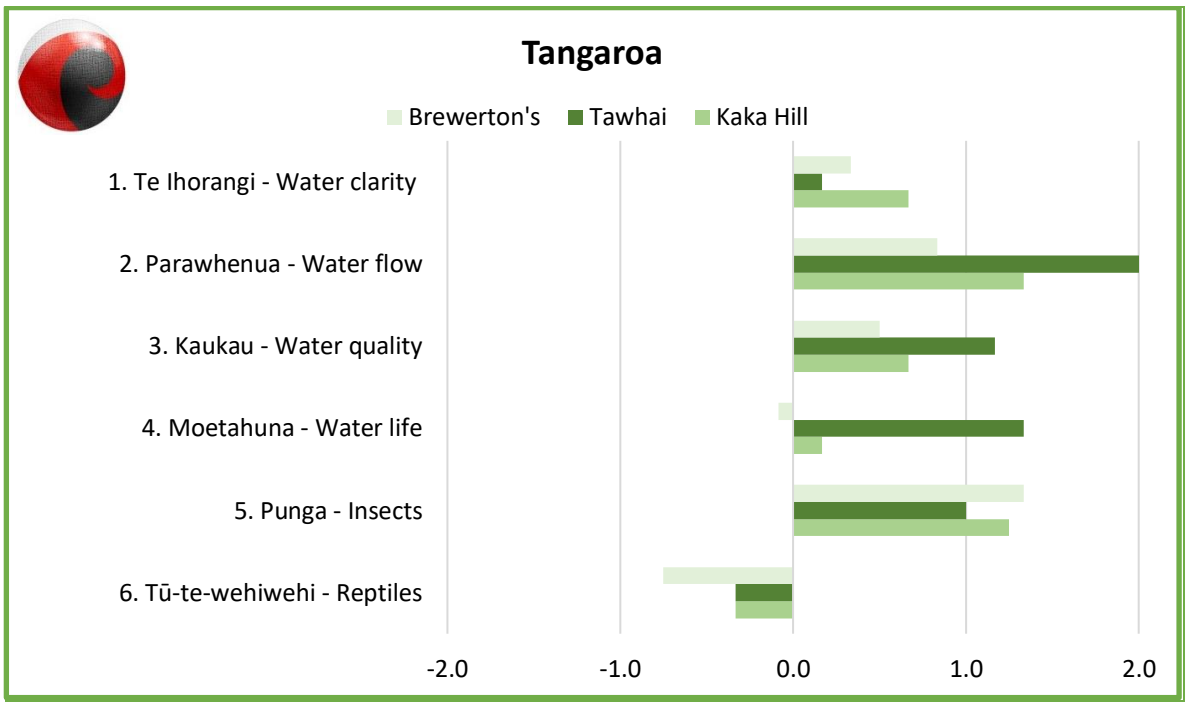


Figure 9: Mean kaitiaki scores for the three forests for each tohu within the domain of Tangaroa (Likert scale where -2 is mauri is in the worst state of health and +2 is in the best state. Scores for all tohu are the mean values assigned by kaitiaki (n=3))

6.2.1 Te Ihorangi of water clarity

When assessing the health of Te Ihorangi the spatial extent over which individual kaitiaki assess a stretch of water can vary. JK, at Kākā Hill for example, included an upstream branch that entered the forest from a recently harvested pine plantation and contained a fine yellow silt. His observation was reflected in his score (-1 as opposed to the mean score of 0.67) (Table 5). At Brewerton's Forest it appears he also assessed a more extensive stretch of stream than the others describing it as 'two dimensional'. "On one side of the concrete ford the water was murky green, on the other side crystal clear". The influence that forest-holders can have on assessments was highlighted, particularly when they inform about the 'usual condition' of tohu rather than actual observations on the day by kaitiaki. At Te Kāinga Tawhai comments by the forest-holders that the "river is not normally like this" due to overnight flooding appeared to have tempered the scoring for Te Ihorangi. Two kaitiaki took what the forest-holders said into account with scores or 0.5 and 1, but the third did not, and scored

the tohu -1. While the influence of forest-holders may affect the scores, the qualitative nature of the assessment reveals much about the health of the tohu.

Table 5: Comments and scores made by kaitiaki about the Te Ihorangi of water clarity tohu.

Kākā Hill	Horopito Stream was described by two kaitiaki as "crystal clear", with scores of 1 and 2 which one would expect from the statement. However, JK described a "Yellow look to the river water" and rated it significantly lower at -1 (mean = 0.67).
Te Kāinga Tawhai	Water clarity was affected by overnight flooding with Scott and Maria telling the research team that it is not normally like this. "Slight sediment (levels) from rain the night before" and "Still in flood, a little bit murky" (mean = 0.17).
Brewerton's Forest	The stream flowed out of the native forest and through a short section of pine forest before crossing the track at a ford. JK described it as "two-dimensional", upstream of the ford being clear with green algae downstream (mean = 0.33).

6.2.2 Parawhenua of water flow

Generally the comments and scores for Parawhenua were in alignment and reflected the observed relative state of health for the three forests (Table 6), i.e., positive and relatively very high.

Table 6: Comments and scores made by kaitiaki about the Parawhenua of water flow tohu.

Kākā Hill	Kaitiaki reported that Horopito Stream had "Good water flow, diversity, rapids and riffles" (mean = 1.33).
Te Kāinga Tawhai	Received high praise and appropriate rating. "Strong water flow, kia kaha". "Awa ki te ātaahua". "High level of diversity, very good flow" (mean = 2.00).
Brewerton's Forest	Water flow was personified as being of a two-dimensional state "having two minds. Slow and not sure of itself". "It had a barrier in the middle but out the other side the creek was saying 'set me free' with a loud shout" (mean = 0.83).

6.2.3 Kaukau of water quality

Generally the comments and scores for Kaukau were in alignment and reflected the observed relative state of health for the three forests (Table 7), i.e., relatively positive.

Table 7: Comments and scores made by kaitiaki about the Kaukau of water quality tohu.

Kākā Hill	"Very strong flow to the river, looks healthy to swim in," "In the summer good to swim in but not good to drink". The rating reflected wider discussions about the adjacent dairy farm (mean = 0.67).
Te Kāinga Tawhai	"Pure water, good to drink" and "Used for swimming during the summer" were typical of the kōrero. The comments were not unexpected given that much of the catchment is in native or regenerating forest (mean = 1.17).
Brewerton's Forest	Again, the two-dimensional state of the stream was referred to which served to downgrade the health of the tohu. "I wouldn't drink (the water)" (mean = 0.50).

6.2.4 Moetahuna of water life

Comments and scores for Moetahuna were based mainly on anecdotal accounts given by the forest-holders of species usually found in their streams rather than any actual observations (Table 8). Comments made by kaitiaki also related to the potential for fish species to be present given the quality of the habitat at all three sites as well as past sightings as relayed by the forest-holders.

Table 8: Comments and scores made by kaitiaki about the Moetahuna of water life.

Kākā Hill	"No fish seen. Owner says that there is tuna (*Anguilla species*) and kōura (*Paranephrops* species)". JK commented "A good place to put a hīnaki [eel net] in" (mean = 0.5).
Te Kāinga Tawhai	"None seen but owner says there are eels and lots of freshwater kōura". In the Clarke River. There are "Eels of good size", "Tuna, kōura, kōaro (*Galaxias brevipinnis*)" and a "Blue duck (*Hymenolaimus malacorhynchos*), one seen (by forest-holders) looking for a mate" (mean = 1.33).
Brewerton's Forest	"No ika [fish] seen. We turned the rocks and saw mayflies", with the presence of mayfly as as a good sign. No tuna (eels) or other water life was seen but Andy said that there is more, lower down the creek (mean = -0.08).

6.2.5 Punga of insect life

The prevalence of wasps (*Vespula* species) at Brewerton's was high and one would have expected the mean score to be the lowest of the three for Punga. However, Brewerton's was actually scored the highest (mean = 1.33) (Table 9). Kaitiaki appeared to make their assessments on total presence

of insects despite the 'invasive' status of wasps. This was the first time pest insects had featured in an assessment although a qualifier was made by one kaitiaki about the wasps with "More needs to be done to eradicate this species".

Table 9: Comments and scores made by kaitiaki about the Punga of insect life tohu.

Kākā Hill	"Lots of flying insects." "Flicking my ears, slapping my skin." "Butterflies in flight" (mean = 1.25)
Te Kāinga Tawhai	**"**Robin[108] was feeding on insects. Insects sound active in the day light". "Kānuka beetle[109] in flight". "Heard cicada – lots of midges" (mean = 1.00)
Brewerton's Forest	"Wasps were in flight". "More needs to be done to eradicate this species". "Had the visual, felt the bites" (mean = 1.33)

6.2.6 Tūtewehiwehi of reptiles

For Tūtewehiwehi no observations were made of reptiles at any of the three sites (Table 10). All forests appear to have similar potential for reptiles to exist, having similar habitat. If observations and potential to exist were the only assessment criteria then all sites should have scored much the same. Kākā Hill and Te Kāinga Tawhai were both rated mean = -0.33 however, Brewerton's mean scored -0.75 for the same tohu. It appears that the difference was a reflection of the levels of knowledge about reptiles on the part of the forest-holders in their respective forests. While the forest-holders at Kākā Hill and Te Kāinga Tawhai had reasonable knowledge about reptiles in their forests, the forest manager at Brewerton's had no knowledge of reptiles in his.

Table 10: Comments and scores made by kaitiaki about the Tūtewehiwehi of reptiles tohu.

Kākā Hill	No reptiles were observed by kaitiaki at Kākā Hill, but lizards are known from the forest (Tony Whitaker 2013 personal communication to Dean) (mean = -0.33).
Te Kāinga Tawhai	Kaitiaki were told by Scott and Maria at Tawhai that skinks and Bell frogs[110] were present in the forest. The site is "Prime habitat" for lizards and frogs (mean = -0.33).
Brewerton's Forest	Brewerton's attracted conflicting opinions "Sign of reptiles here" and "None seen. Lots of fallen trees and good habitat" (mean = -0.75).

[108] *Petroica australis*
[109] *Pyronota festiva*
[110] *Litoria* species

6.3 Tāne

Tāne is the Atua of forests and birds. Below is a summary of the quantitative data (Figure 10) and qualitative data (Tables 11 to 23) from the three study forests for the 13 tohu within his domain.

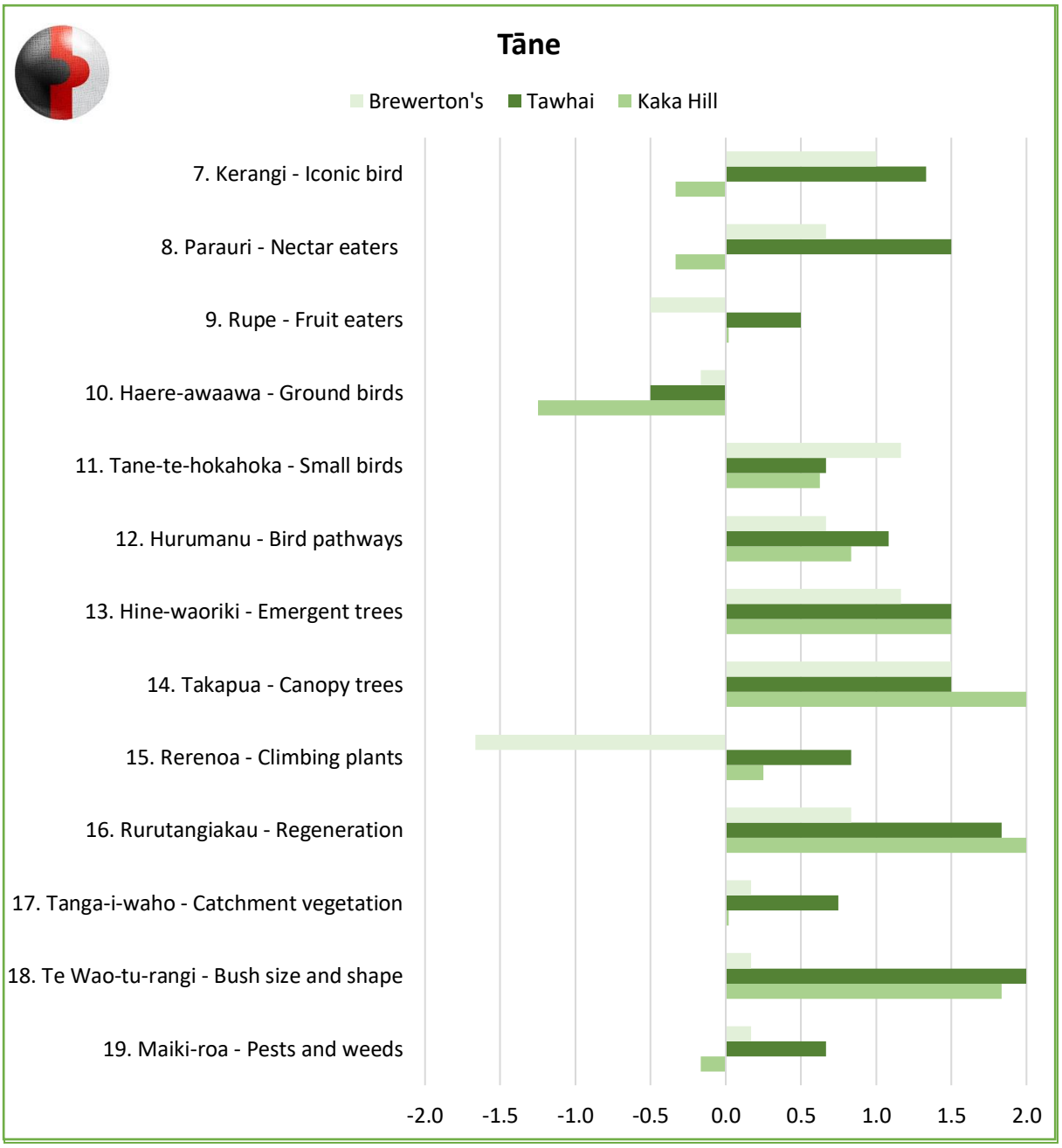


Figure 10: Mean kaitiaki scores for the three forests for each tohu within the domain of Tāne (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for all tohu are the mean values assigned by kaitiaki (n = 3)).

The state of health for all three forests was reasonable, for the most part attaining positive responses, particularly in relation to the flora tohu. The exception was Rerenoa at Brewerton's Forest, which appeared to be related to the lack of knowledge of climbing plants by the forest holder as much as a lack of observations of these on the part of kaitiaki. In terms of birds the results were more mixed. Tāne-te-hokahoka of small birds and Hurumanu of bird pathways attracted good responses for the three forests and Haere-awaawa of ground birds was rated poorly across all three.

6.3.1 Forest kaitiaki

The scores for 'Forest kaitiaki' reasonably reflected the kōrero for two of the three forests but not Kākā Hill (Table 11). Kaitiaki were told about a flock of 20 kākā had been seen recently, although the normal presence of kākā was more like two to six birds. On the day two birds were seen which attracted a score of mean = 0.33. This seems to be underscored, particularly in comparison to Brewerton's (mean = 1.00) where kārearea (*Falco novaeseelandiae*) was identified as the iconic bird species, but none were seen and Te Kāinga Tawhai where there was plenty of birds but no specific species was identified by the forest holders as being 'iconic' (mean = 1.33). The logical explanation is that the narrative by the forest-holder of the large flock kākā served to raise expectations and when these were not met this attracted a low score.

Table 11: Comments and scores made by kaitiaki about the forest kaitiaki tohu

Kākā Hill	Kaitiaki were told by Dean that the iconic species of Kākā Hill, kākā, are established in the wider forest area with normally two to three pairs present. He said that flocks of up to 20 birds have been seen within the last year. While two kākā were observed on the day, the tohu attracted the lowest score of the three forests (mean = 0.33).
Te Kāinga Tawhai	"All in numbers". No single iconic bird was identified by Scott and Maria but they did mention korimako[111], toutouwai[112] and pīpīwharauroa[113] as contenders (mean = 1.33).
Brewerton's Forest	Initially Andy said that he could not think of an iconic bird for Brewerton's however, he spoke fondly about the falcon (kārearea) which is prevalent throughout Golden Downs (mean = 1.00).

[111] *Anthornis melanura*
[112] *Petroica australis*
[113] *Chrysococcyx lucidus*

6.3.2 Parauri of nectar feeders

Generally the comments and scores for Parauri were in alignment and reflected the observed relative number of tūī and be the three forests (Table 12).

Table 12: Comments and scores made by kaitiaki about the Parauri of nectar feeders tohu

Kākā Hill	Dean told the team that tūī and bellbirds are always present. "Honey birds sounding off." While birds were heard, few were observed by team members. Of the three forests Kākā Hill attracted the lowest score for Parauri (mean = -0.33).
Te Kāinga Tawhai	Tūī and korimako (bellbirds) observed. "Five pairs of tūī have come back due to owners cleaning out pests" (mean = 1.5).
Brewerton's Forest	Both bellbirds and honeydew were made mention of by JK reflecting on an earlier whakatauākī - "Tūī heard and seen, still singing, still full of honey (mean = 0.67).

6.3.3 Rupe of fruit-eaters

The scores for Rupe for both Kākā Hill (mean = 0.00) and Te Kāinga Tawhai (mean = 0.50) appear over-inflated, particularly given that no kererū were observed at Kākā Hill, only one at Te Kāinga Tawhai, whilst two were observed near Brewerton's which only achieved a mean score = -0.50 mean (Table 13). The obvious reason for the relatively high scores for the first two forests seems to be related to accounts and numbers given by the forest-holders of the seasonal visits of kererū and expectations not being met. While the forest-holder at Brewerton's was able to say that kererū are seasonal visitors he was not able to elaborate. Further, it appears that the scores were not updated to reflect later observations. No kererū had been observed at Brewerton's when the tohu was discussed, but later JK wrote "two pair seen in lower areas of the forest". The score is not reflective of two pair, particularly in comparison to Kākā Hill where none were seen and Te Kāinga Tawhai where one was seen. Two pair at Brewerton's should have attracted a score above 0.5, and while JK made comments of this observation he did not update his score. This phenomenon occurred again with the research team making later observations of *Haere-awaawa of Ground birds*, but not updating their scores to suit.

Table 13: Comments and scores made by kaitiaki about the Rupe of fruit-eaters tohu

Kākā Hill	"None (were) seen or heard". The team was told by Dean that kererū are seasonal visitors attracted by the wineberry and fuchsia in the gullies (mean = 0.00).

Te Kāinga Tawhai	Scott and Maria told the group that kererū are occasional visitors to the forest and that their numbers were climbing. One kererū was observed during our visit (mean = 0.50).
Brewerton's Forest	Andy said that wood pigeons were around seasonally. Initially no kererū were observed but later "two pair (were) seen in lower areas of the forest" (mean = - 0.50).

6.3.4 Haere-awaawa of ground birds

Generally the comments and scores for Haere-awaawa were in alignment and reflected the observed number of ground birds in each of the three forests (Table 14).

Table 14: Comments and scores made by kaitiaki about the Haere-awaawa of ground birds tohu

Kākā Hill	No ground birds were seen or heard. Dean said that he had only ever seen one weka[114] and the tohu was rated accordingly (mean = -1.25).
Te Kāinga Tawhai	Weka were reported by Scott and Maria as occasional visitors but have not established possibly because of their preference for scrublands and forest edge (mean = -0.50).
Brewerton's Forest	"Ground birds should be here". "A weka was seen crossing the road". "On the way out - a pūkeko[115]". We continued an ongoing conversation about the general return of weka in the region (mean = -0.17).

6.3.5 Tāne-te-hokahoka of small birds

The kōrero for Kākā Hill and Te Kāinga Tawhai for Tāne-te-hokahoka was similar for the two forests and reflected in their scores (mean = 0.63 and 0.67) (Table 15). However, Brewerton's was scored the highest of the three forests (1.17) despite introduced species making up a significant portion of the birds observed, such as sky larks and finches, which are ubiquitous in the surrounding clear-cut lands. Kaitiaki did not appear to differentiate between introduced and indigenous species giving them similar weighting. The lack of differentiation between native and exotic species gave unexpected results. This is an issue which had not arisen previously because in the other five forests assessed indigenous bird species dominated.

[114] *Gallirallus australis*
[115] *Porphyrio melanotus*

Table 15: Comments and scores made by kaitiaki about the Tāne-te-hokahoka of small birds tohu

Kākā Hill	"I hear many singing. Fantail, tomtits, warbler, robin." "Kaha waiata." "Robin in big numbers, they are quick off the mark to outsmart the predators" (mean = 0.63).
Te Kāinga Tawhai	"Small birds run the place. The trees are alive with them". "Many species – toutouwai, ngirungiru[116], pīwakawaka[117], pīpipi[118]" (mean = 0.67).
Brewerton's Forest	"Mainly hear the sound of these birds", skylark[119], finches and wax eye[120]. Robins were prevalent in the forest (mean = 1.17)

6.3.6 Hurumanu of bird pathways

The kōrero, scores and ranking of Hurumanu reflected the degree of connection to surrounding native forest (Table 16). Te Kāinga Tawhai is connected to Kahurangi National Park on two sides so was scored the highest of the three forests as might be expected (mean = 1.08). Conversely, Brewerton's Forest is an isolated island of indigenous forest surrounded by a sea of pine plantation (mean = 0.67).

Table 16: Comments and scores made by kaitiaki about the Hurumanu of bird pathways tohu

Kākā Hill	"Good bird pathways go north to south". Kākā Hill is an island of native forest surrounded by a mix of land uses – exotic forestry, dairy farm, a lifestyle block with thin connections to Big Bush Conservation Forest (mean = 0.83).
Te Kāinga Tawhai	"Lots of birds flying – from the kāhu[121] to the pīwakawaka". "Oh, to wake with the sounds of birds singing" (mean = 1.08).
Brewerton's Forest	Brewerton's is an island of indigenous forest set in a sea of pine plantations. It has a covenanted peninsula out into this sea, which is bisected by a forestry track. "Bird flight path from plantation to plantation or do they just go from tree to tree?" and "A good pathway following quite a natural gully" (mean = 0.67).

[116] *Petroica macrocephala*
[117] *Rhipidura fuliginosa*
[118] *Mohoua novaeseelandiae*
[119] *Alauda arvensis*
[120] *Zosterops lateralis*
[121] *Circus approximans*

6.3.7 Hine-waoriki of emergent trees

All three forests have emergent trees despite some past logging of podocarp species and all scored similarly in the 1 to 1.5 range for Hine-waoriki as one might expect (Table 17).

Table 17: Comments and scores made by kaitiaki about the Hine-waoriki of emergent trees tohu

Kākā Hill	"Emergent trees are coming back". "Owner also replanting" kahikatea and matai[122]. Rimu was subject to targeted logging in the 1940s and again in the late 1960s (mean = 1.50).
Te Kāinga Tawhai	Originally the river flats were covered in kahikatea. There are some old ones left, with planting and natural regeneration underway. The kōrero centred on kahikatea and its health despite the location being known for its strong winds (mean = 1.50).
Brewerton's Forest	"Windfall trees make the forest look heartbroken" declared one kaitiaki. Brewerton's was scored the lowest amongst the three forests but still reasonably healthy (mean = 1.17).

6.3.8 Canopy trees[123]

The three forests were also rated highly for canopy trees which is also probably to be expected given that they are all intact old growth forests with minimal or low levels of harvest (range 1.5 to 2.0) (Table 18).

Table 18: Comments and scores made by kaitiaki about the canopy trees tohu

Kākā Hill	"Good windfall harvest. Beech harvestable", "Beech trees… healthy and ready for harvest". The forest contains a range of native beech species and forest stands at different stages of growth from regeneration to mature (mean = 2.00).
Te Kāinga Tawhai	"Many species – healthy", "After twenty years of owners being here and the work that they are doing this place has come back so strong". Contains a number of beech species (silver, black and hard) (mean = 1.5).
Brewerton's Forest	"The canopy trees are looking good and reaching for the sky", however, problems were also identified. "A lot of the trees have died off (along the edge). Is this due to the spray used in the catchment?" Despite the concern expressed this tohu was rated the highest for Brewerton's across the full suite of tohu (mean = 1.5).

[122] *Prumnopitys taxifolia*
[123] No poutiriao is given here for canopy trees as the poutiriao changes depending on the species of trees

6.3.9 Rerenoa of climbing plants

The forest-holders lack of knowledge of tohu sometimes appears to attract lower scores. This was most obvious on the scores given to Rerenoa (Table 19). A few observations of climbing plants were made at Kākā Hill (two species of mistletoe, mean = 0.25) and Te Kāinga Tawhai (two species of mistletoe and one species of rata[124], mean = 0.83). No observations of climbing plants were made at Brewerton's however the tohu was scored significantly lower (mean = -1.67), much lower than might be expected compared to the few observations made at the other two forests. The very low score for Brewerton's appears to be based, at least in part, on the lack of knowledge by the forest-holder about mistletoe and rata in his forest.

Table 19: Comments and scores made by kaitiaki about the Rerenoa of climbing plants tohu

Kākā Hill	Two species of New Zealand mistletoe were shown to the team by Dean. Kaitiaki were told that mistletoe was making a comeback due to recent possum control (mean = 0.25).
Te Kāinga Tawhai	Kaitiaki were shown red and yellow mistletoe as well as rata. Maui simply described the tohu as "healthy" (mean = 0.83).
Brewerton's Forest	"None noted but if spent more time here there would (probably) be some". Kaitiaki could not find any of the climbing plants which one may have expected there, such as mistletoe or native clematis[125] (mean = -1.67).

6.3.10 Rurutangiakau of regeneration

At Brewerton's Forest, the scoring in relation to Rurutangiakau was not aligned to the diversity in opinion between the kaitiaki with a narrow range between the lowest and highest scores of only 0.5 to 1.0 (s.d. = 0.17). The mean score of 0.83 was relative to the other two forests, however (Table 20).

Table 20: Comments and scores made by kaitiaki about the Rurutangiakau of regeneration tohu

Kākā Hill	The research team observed plentiful regeneration of beech with the discussion centred on regeneration in relation to beech mast years (mean = 2.00).
Te Kāinga Tawhai	"Regeneration is awesome" and "This place is ready to take off". The sentiment explains the high rating (mean = 1.83).

[124] *Metrosideros umbellata*
[125] *Clematis paniculata*

Brewerton's Forest	There were conflicting views about regeneration from "Good regeneration," and "Great regeneration of beech etc. Rimu?" reported to "The regeneration doesn't look healthy. What is going on in this forest?" (mean = 0.83).

6.3.11 Tangi-i-waho of catchment vegetation

The scores and comments in relation to Tangi-i-waho would be expected to align with the relative amount of indigenous vegetation or the mix of vegetation types in the sub-catchment (Table 21). Brewerton's Forest has no other significant areas of indigenous vegetation within its sub-catchment other than Brewerton's itself (8.4% native forest) (Table 22).

Table 21: Comments and scores made by kaitiaki about the Tangi-i-waho of catchment vegetation tohu

Kākā Hill	Exotic forestry, farming, indigenous forest and scattered bush in the catchment makes for a diverse landscape and works well together. JK's score (-1.75) did not match his kōrero (mean = -0.58).
Te Kāinga Tawhai	Kaitiaki felt that the forest-holders had the best "Vision in the catchment area" in terms of their guardianship of their forest and that "(Others in the catchment) need to step up to the owners of this forest" (mean = 0.75).
Brewerton's Forest	JK declared "Plantation, plantation. We need more areas for native bush. The exotic has taken over and the native forest has been left aside" (mean = 0.17).

The sub-catchment of Kākā Hill has a reasonable diversity of vegetation types including indigenous vegetation (65% native forest). Te Kāinga Tawhai is made up of a mix of unmodified and regenerating indigenous vegetation (77.1% native forest).

One would expect the scores to roughly reflect this pattern. For each of the forests the comments made by kaitiaki did reflect this, however the scores were not aligned to the kōrero. Kākā Hill was scored -0.58 being the lowest score of the three. Even Te Kāinga Tawhai with a mean score of 0.75 was surprisingly low given the high proportion of indigenous forest and regeneration forest within the sub-catchment. Brewerton's mean score of 0.17 seems generous given the lack of diversity in the sub-catchment. This suggests issues of spatial awareness on the part of kaitiaki.

Table 22: Comparison of vegetation types within the sub-catchments of the three study forests[126]

	Kākā Hill	Brewerton's	Te Kāinga
Area of Sub-catchment (ha)	3813	2279	3284
Native forest %	65.1	8.4	77.1
Regenerating forest %	2.8	0.0	19.8
Pine plantation %	22.2	91.6	0.0
Pasture %	9.8	0.0	0.1
Alpine %	0.0	0.0	3.0
Total %	100.0	100.0	100.0

6.3.12 Te Wao-tū-rangi of forest size and shape

Two of the three forests were personified by kaitiaki in describing Te Wao-tu-rangi (Table 23). Te Kāinga Tawhai was described as a "hapū wahine" – compared to a pregnant woman. Kākā Hill was described as a "fat old Māori boy". This somewhat curious comment was later discussed with the kaitiaki and interpreted as *fat* as in biomass, *old* as in ancient, and *Māori boy* as in indigenous. A personified description provides an image of each forest and the scores neatly reflected each forest's space and mass attracting mean scores of 0.17 for Brewerton's, 1.83 for Kākā Hill and 2.00 for Te Kāinga Tawhai.

Table 23: Comments and scores made by kaitiaki about the Te Wao-tu-rangi of forest size and shape tohu

Kākā Hill	JK wrote that the "Forest is shaped like a fat old Māori boy" (mean = 1.83).
Te Kāinga Tawhai	Te Kāinga Tawhai scored the highest for this tohu of the three forests and attracted comments such as "Huge, with growth potential" and "Hapū wahine" (mean = 2.00).
Brewerton's Forest	Brewerton's was described as "Quite diverse shape and size". "Covenanted forest – long and thin, the other forest block – long and wide". It was difficult to visualise the forest shape without a distant view, aerial photograph or a map (mean = 0.17).

[126] Figures obtained through GIS exercise using QGIS software. Note: roads and streams and other non-vegetated areas have not be differentiated out but are incorporated into the vegetation types which they pass through.

6.3.13 Maiki-roa of weeds and pests

The scores of the three forests in relation to Maiki-roa appear to reflect the level of knowledge and commitment by the forest-holders to weed and pest control rather than simply being based on observations of pests and weeds (Table 24). Te Kāinga Tawhai has an ongoing programme (mean = 0.67), Brewerton's controls pests and weeds sporadically (mean = 0.17), and while a possum control programme had been undertaken at Kākā Hill it had faltered in recent years (mean = -0.17). The statement "Blackberry – it's a feed" from Te Kāinga Tawhai was a familiar kōrero and conservation dilemma for the research team summed up by the often referred to whakatauākī from Pat Park, "Is it a weed or is it a feed?" On one hand, an introduced plant or animal can be a source of food or useful products (such as meat from pigs or deer, or fibre from possums). On the other hand, their presence in the forest may be negatively affecting the forest ecosystem and therefore by definition be a pest species.

Table 24: Comments and scores made by kaitiaki about the Maiki-roa weeds and pests tohu

Kākā Hill	The sub-catchment of Kākā Hill was included in a bovine TB control programme (2002 to 2011) focused on possums. Dean said that trapping and poisoning had led to a significant drop in possum numbers and a rise in the presence of mistletoe (mean = - 0.17).
Te Kāinga Tawhai	"Blackberry – it's a feed". A weed and pest programme had been implemented by Scott and Maria since they had taken over the property. A trap-line was walked and checked by the group, and a dead stoat was found in one trap (mean = 0.67).
Brewerton's Forest	"Gorse, broom, pampas, buddleia – *Velpar* controlled". "Pests have been hammered by 1080." Pest plants were discussed with signs of spraying alongside the roadway noted. The use of 1080 and trapping was discussed as part of the control of bovine TB (mean = 0.17).

6.4 Tāwhirimātea

Tāwhirimātea is the Atua of weather and climate. Below is a summary of the quantitative data (Figure 11) and qualitative data (Tables 25 and 26) collected at the three study forests for the two tohu that were developed, tested and validated within his domain. Kākā Hill and Te Kaainga Tawhai drew positive responses for the health of these two tohu and Brewerton's Forest was assessed as mediocre on both counts.

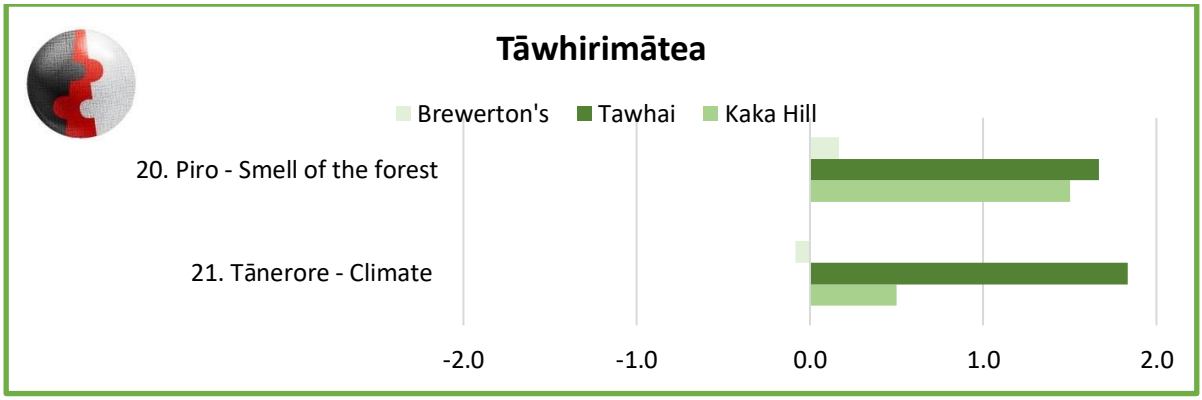


Figure 11: Mean kaitiaki scores for the three forests for each tohu within the domain of Tāwhirimātea (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for all tohu are the mean values assigned by kaitiaki (n =3)).

6.4.1 Piro of the smell of the forest

Piro was scored by kaitiaki positively at all three forest sites (Table 25). This was expected as all forests are old growth in rural settings. The lower score from Brewerton's (mean = 0.17) was possibly influenced by the surrounding pine forest and cutover forest or perhaps it was due the weather which was warmer and drier than the visits to Kākā Hill and Te Kāinga Tawhai.

Table 25: Comments and scores made by kaitiaki about the Piro of smell of the Forest tohu

Kākā Hill	Amongst the kōrero "Ātaahua smell, healthy damp smell" and "The smell of spring is as sweet as nectar" (mean = 1.50).
Te Kāinga Tawhai	Positive kōrero with "Just rained – smells awesome" and "Fresh, clean, sweet as bro!" (mean = 1.67).
Brewerton's Forest	"Smells earthy – sweet" and "Sweet sour smell of honey-dew" (mean = 0.17).

6.4.2 Tānerore of climate

The difference in the scores across the three forests for Tānerore cannot be readily explained (Table 26). However, the kōrero centred on climate change and the effects on species which are currently at their southern or an altitudinal limit and how warmer weather may allow these species to expand their distribution.

Table 26: Comments and scores made by kaitiaki about the Tānerore of climate tohu

Kākā Hill	Rimu were identified as being on the edge of their altitudinal limit and a possible tohu species of climate change. The forest-holder said that climate change appeared to be having a positive effect on rimu regeneration in his forest. "The sun brings a smile to everyone's face and a shine to a bark forest" (mean = 0.50).
Te Kāinga Tawhai	Neinei (*Dracophyllum traversii*) and toatoa (*Phyllocladus toatoa*) were identified by the forest-holders as possible tohu species of climate change. One kaitiaki said that the "Forest is claiming back" in reference to shifting habitat limits (mean = 1.83).
Brewerton's Forest	Rimu were identified as a tohu species of climate change. "Rimu are coming away a lot more. This could be because of the season [climate] changing" (mean = - 0.08).

6.5 Tūmatauenga

Tūmatauenga is the Atua of people and war. Below is a summary of the quantitative data (Figure 12) and qualitative data (Tables 30 to 35) collected at the three study forests for the six tohu that were developed, tested and validated within his domain.

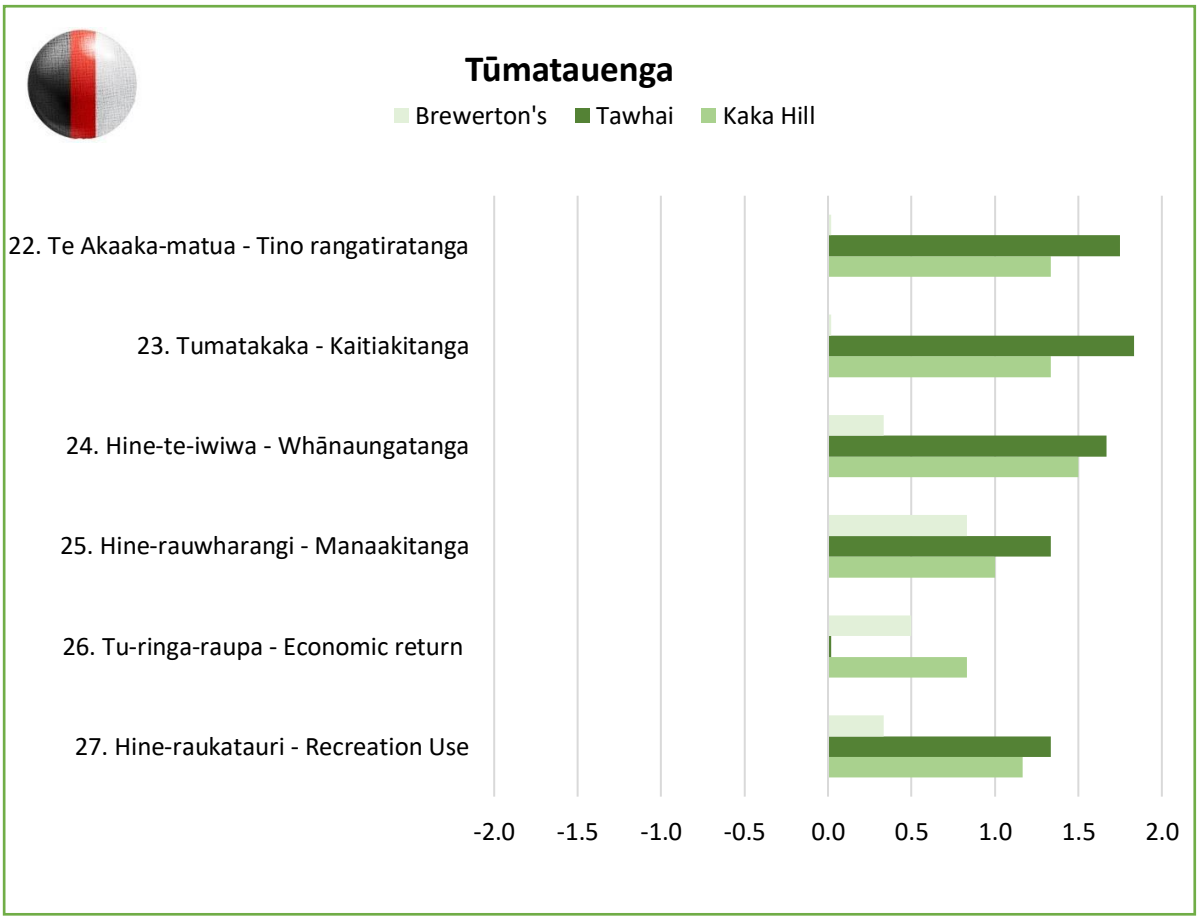


Figure 12: Chart of the mean kaitiaki scores for the three forests for each tohu within the domain of Tūmatauenga (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for all tohu are the mean values assigned by kaitiaki (n=3)).

The state of health for all three forests was reasonable, attaining positive responses (i.e. above mean = 0). Brewerton's Forest was rated the lowest of the three forest for five of the six tohu. This was directly related to pending change in the landholders from the Crown to iwi entities. While the scores were low the sentiments expressed in the kōrero about the change was positive.

6.5.1 Te Akaaka-matua of tino rangatiratanga

The topic of conversation at all forests around Te Akaaka-matua concerned issues of self-determination in respect of forest-holders to govern their forests, assisted or encumbered by government authorities (Table 27). The neutral score for Brewerton's is probably reflective of anticipation iwi groups have of forestlands being returned as part of a Treaty settlement rather than any restrictions the forest-holder feels they have on their ability to manage their forest. Kaitiaki made reference to all the forest-holders as 'kaitiaki'. They assessed the health of Te Akaaka-matua not from their own perspective as kaitiaki but from the perspective of the forest-holders as kaitiaki.

Table 27: Comments and scores made by kaitiaki about the Te Akaaka-matua of tino rangatiratanga

Kākā Hill	The forest-holder described his ability to manage his forest in light of government regulation as "not too bad". He said permits are required for him to harvest timber, which he supported, was positive about the government not charging for the permits and saw his development of a SFM plan as a priority (mean = 1.33).
Te Kāinga Tawhai	"Kingship – from the kaitiaki". *Kaitiaki* is used to refer to the guardianship role of the forest-holders. Scott and Maria were positive about their ability to be decision makers in the management of their forest under QE II Trust (mean = 1.75).
Brewerton's Forest	"Settlement partnership, hopefully (tino rangatiratanga) moves up". Brewerton's formed part of a recent Treaty of Waitangi settlement. Discussion centred round the partnership between iwi and NFL (the forest managers) (mean = 0.00).

6.5.2 Tumatakaka of kaitiakitanga

Once again, the forest-holder was viewed as the kaitiaki of the forest rather than the kaitiaki in the research team when assessing the health of Tumatakaka. The tohu was rated similarly to the previous tohu across the three forests, being a closely related tohu (Table 28). Again the neutral score for Brewerton's appears to reflect the anticipation of the return of the forestlands to iwi under their Treaty settlements and the development of new partnerships with the forest-holders.

Table 28: Comments and scores made by kaitiaki about the Tumatakaka of kaitiakitanga tohu

Kākā Hill	Kaitiaki wrote of Dean, "A guardian of kaitiakitanga. Needs more like-minded people." Discussion centred on low levels of timber harvest destined for local people and community projects only (mean = 1.33).

Te Kāinga Tawhai	Scott and Maria were described as "very committed to the role of kaitiaki of the ngahere and those that live amongst it" and "top of the tree people". The QE II Trust conservation covenant was discussed along with the commitment of the forest-holders to their conservation path (mean = 1.83).
Brewerton's Forest	Through a Treaty settlement iwi are "Getting the mana of the forest back so we can be kaitiaki". The score signifies that NFL as 'kaitiaki' is 'ok' at present but iwi are wanting more from their partnership (mean = 0.00).

6.5.3 Hine-te-iwaiwa of whanaungatanga

Hine-te-iwaiwa concerns the strength of the relationships between people and the forests (Table 29). Kākā Hill and Te Kāinga Tawhai both have forest-holders occupying their forests for extended periods at a time. Their relationships are well-developed and stronger than Brewerton's where the forest-holder does not occupy his forest or stay overnight. The relationships are aligned to the scores made.

Table 29: Comments and scores made by kaitiaki about the Hine-te-iwaiwa of whanaungatanga tohu

Kākā Hill	"Awesome relationship with whenua, minimal clearing of forest for humans, ki te rohe ātaahua". There are good relationships between people and the physical and spiritual dimensions of the forest (mean = 1.50).
Te Kāinga Tawhai	"People staying here are taught the right way". "Great aroha to the whenua, ngahere, wairua". Kaitiaki felt that Scot and Maria have a great bi-cultural relationship with the forest (mean = 1.67).
Brewerton's Forest	"God made this world. We have a duty to care for it". Kaitiaki said that they were hopeful that the Treaty settlements will provide greater opportunities for the development of relationships between people and forests (mean = 0.33).

6.5.4 Hine-rauwharangi of manaakitanga

Hine-rauwharangi concerns the ability of forest-holders to provide sustenance to their visitors. The forest-holders at Kākā Hill harvest timber for the needs of family and friends (mean = 1.00) (Table 30). All the forests provide experiences to visitors, however education is an important part of the Te Kāinga Tawhai experience reflected in the score (mean = 1.33).

Table 30: Comments and scores made by kaitiaki about the Hine-rauwharangi of manaakitanga tohu

Kākā Hill	Dean said that he "only took what the forest gave him". Only wind-fallen trees and dead standing trees are taken. The ecological value of rimu is higher than its economic value and the species is not targeted (mean = 1.00).
Te Kāinga Tawhai	"Owners run groups and teach knowledge of the ngahere". "Great potential of the ngahere – well done". Timber is not harvested but what is 'harvested' is knowledge and learning (mean = 1.33).
Brewerton's Forest	Kaitiaki commented that at present there is "non-harvest – but this could change in the future" (for indigenous species) under iwi management (mean = 0.83).

6.5.5 Tū-ringa-raupa of economic wellbeing

Tū-ringa-raupa was introduced in the final version of the Ketewhaihua (from V6 onwards). The 'breaking even' comments at Kākā Hill would suggest a mean score of around 0.00, because one is neither making nor losing money, however, the mean = 0.83 suggests a level of 'over-scoring' perhaps related to the potential of the forest to provide economic returns (Table 31). The kōrero at Te Kāinga Tawhai suggests a score below midpoint because the cost of owning the forest outweighs its ability to pay these costs. Here the score also suggests slight over-scoring. This may be related to the economic potential of the forest.

Table 31: Comments and scores made by kaitiaki about the Tū-ringa-raupa of economic wellbeing tohu

Kākā Hill	"A good man always weighs up the cost" wrote JK about the ability of a forest-holder to balance competing conservation – development initiatives. Hori commented that Dean told him that the forest is "breaking even" financially (mean = 0.83).
Te Kāinga Tawhai	Maui reported "There are big payments – but not of money". Scott and Maria said that the forest does not pay for itself in an economic sense. "These people are not looking to make money. Their aroha of the ngahere is very strong" (mean = 0.00).
Brewerton's Forest	Hori felt that the forest was "Blessed with quietness", and Maui that the "Forest seems too young for a good harvest – e tēnei wā[127]" (mean = 0.50).

[127] *e tenei wa* ≈ at this time

6.5.6 Hine-raukatauri of recreation

The scores and comments of appear to be reflective of the relative importance of recreation in the three forests (Table 32). The main purpose for Te Kāinga Tawhai is conservation, which provides for several education and recreation opportunities. These are also important at Kākā Hill, although production forestry restricts recreation activities to an extent. While hunting, biking and horse riding were stated activities at Brewerton's forest, these were cursory to the forest's main purpose as a conservation forest.

Table 32: Comments and scores made by kaitiaki about the Hine-raukatauri of recreation tohu

Kākā Hill	Hori said Kākā Hill was "A good place to reminisce and think". Maui said that the forest was "top notch" for a range of recreational activities (mean = 1.17).
Te Kāinga Tawhai	Te Kāinga Tawhai scored the highest of the three forests for recreation accompanied by comments such as "A pursuit of pleasure" and "No footprints left" (mean = 1.33).
Brewerton's Forest	Kaitiaki reflected with Andy on recreation opportunities currently undertaken in the forest including "Hunting, biking, tramping? Horse-riding" (mean = 0.33).

6.6 Rongomātāne

Rongomātāne is the Atua of cultivated food and peace. Below is a summary of the quantitative data (Figure 13) and qualitative data (Tables 33 and 34) collected at the three study forests for the two tohu that were developed, tested and validated within his domain.

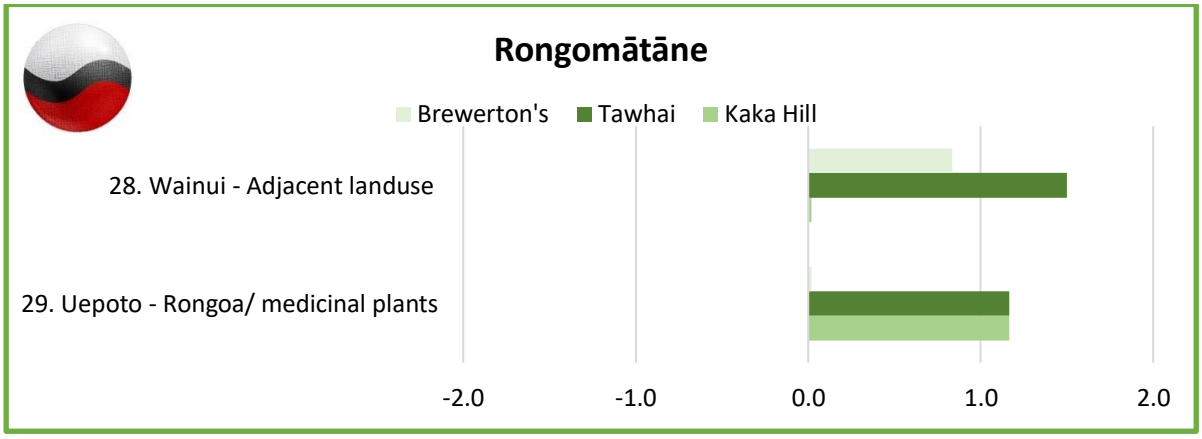


Figure 13: Chart of the mean kaitiaki scores for the three forests for each tohu within the domain of Rongomātāne (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for all tohu are the mean values assigned by kaitiaki (n=3)).

The state of health of both of these tohu for Te Kaainga Tawhai was assessed to reasonable (i.e. > 1). At Kākā Hill, Wainui was rated at mean = 0 due to the negative effects of the adjacent dairy farm.

Brewerton's was rated mean = 0 for Uepoto due its lack of medicinal plants in comparison to the other two forests.

6.6.1 Wainui of adjacent land-use

The comments that the kaitiaki made in relation to Wainui for all three forests were reasonably positive (Table 33). Conversations at all three forests revolved around forest edges as well as adjacent land-use. The scores for Te Kāinga Tawhai and Brewerton appear to broadly reflect the kōrero, however it appears that Kākā Hill was perhaps underscored but may be related to discussions around the adjacent dairy farm and the forest-holders views about their negative environmental effects.

Table 33: Comments and scores made by kaitiaki about the Wainui of adjacent land-use tohu

Kākā Hill	Hori – "Good working relationship with farming and forestry." Maui – "Some hard (edges), some soft" (mean = 0.00.).
Te Kāinga Tawhai	"One edge integrated (with national park), one edge harder with road and pines". This forest was rated the highest of the three probably because of a long shared border with Kahurangi National Park (mean = 1.50).
Brewerton's Forest	Kaitiaki felt that the indigenous and plantation forest had a "Good relationship", "Pines – semi soft edge" and noted that "This area has been looked after by the people of the catchment" (mean = 0.83).

6.6.2 Uepoto of rongoā

Assessing the health of Uepoto was problematic for the research team as it involves specialised knowledge of medicinal plants, the quality of the resource and their populations. Kaitiaki were able to identify a variety of medicinal plants at all three forests and felt that some species could probably be sustainably harvested. They individually admitted that their rongoā knowledge was incomplete, however, their collective knowledge was not insignificant. As their knowledge grows about rongoā, or kaitiaki who have more knowledge are involved in the assessment, the ratings should more closely match their kōrero (Table 34).

Table 34: Comments and scores made by kaitiaki about the Uepoto of rongoā tohu.

Kākā Hill	Kaitiaki referred to two rongoā species at harvestable levels, horopito and fuchsia, but because their rongoā knowledge was limited they were unable to comment on the quality of the resource (mean = 1.17).
Te Kāinga Tawhai	Comments on the variety of rongoā species included "Many plants for rongoā. Horopito, flax, karamu and many others" but they could not comment on the quality of the plants (mean = 1.17).
Brewerton's Forest	Lacking knowledge of rongoā in relation to the area was a discussed, both from perspectives of the kaitiaki and forest manager (mean = 0.00).

6.7 Haumietiketike

Haumietiketike is the Atua of fern root and wild food. Below is a summary of the quantitative data (Figure 14) and qualitative data (Tables 35 and 36) collected at the three study forests for the two tohu that were developed, tested and validated within his domain. The state of health of Patekateka was mediocre for all three forests, this being both a reflection on the lack of knowledge of these plants and animals on the part of kaitiaki as much as a lack of mahinga species.

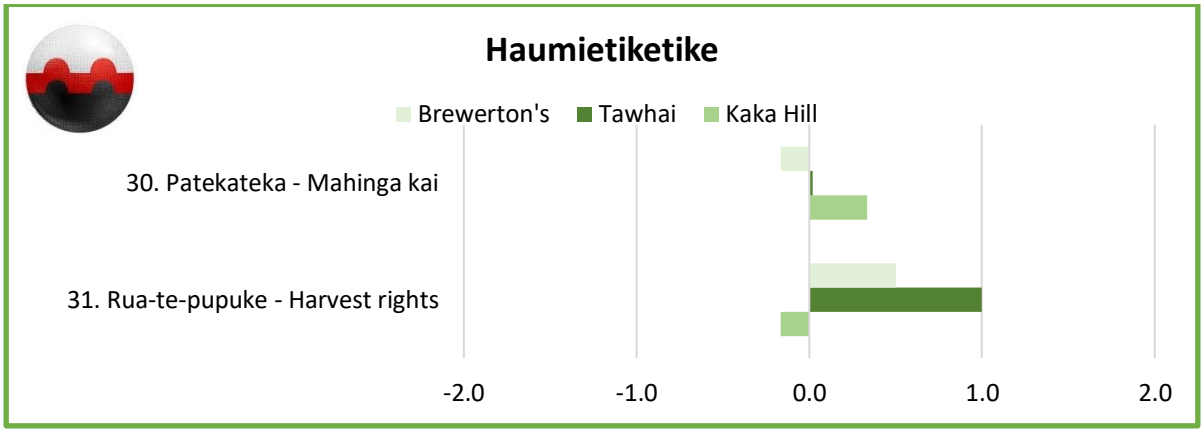


Figure 14: Chart of the mean kaitiaki scores for the three forests for each tohu within the domain of Haumietiketike (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for both tohu are the mean values assigned by kaitiaki (n=3)).

6.7.1 Tahu of mahinga kai

The scores Tahu from the three forests suggest that mahinga kai levels in all three forest are lower than traditional levels, with Kākā Hill being the only forest with levels of sustainable harvest above 0.00 available (Table 35).

Table 35: Comments and scores made by kaitiaki about the Tahu of mahinga kai tohu

Kākā Hill	Dean told the kaitiaki that wild foods in the forest included "deer, pigs, honey dew, occasional ducks, and quail" (mean = 0.33).
Te Kāinga Tawhai	"Not a lot of kai". Kaitiaki were told that there are low levels of pigs, deer and possums but that these 'pests' are being eradicated (mean = 0.00).
Brewerton's Forest	Hori wrote that there was "not much in the beech forest" in the way of wild food and that beech forests tend to be lacking in mahinga kai (mean = - 0.17).

6.7.2 Rua-te-pupuke of harvest rights

In the earlier prototypes of the Ketewhaihua there was often confusion over Rua-te-pupuke as its description included 'access' and whether this pertained to a right of access to forest products or physical access to the site. The tohu was changed to 'harvest rights' in the final prototype to clarify the position. While there was quite a wide discrepancy between kaitiaki at each of the 3 sites, particularly Kākā Hill (standard deviation = 1.77) their collective understanding of the health of the tohu from their kōrero is more united (Table 36).

Table 36: Comments and scores made by kaitiaki about the Rua-te-pupuke of harvest rights tohu

Kākā Hill	The forest-holder told the research team that there was no existing right to harvest native trees, but a right can be obtained through an application to the Ministry of Primary Industries (mean = - 0.17).
Te Kāinga Tawhai	A QEII conservation covenant does not allow the harvest of indigenous species. Kaitiaki felt that there was "no need to harvest" because the harvest at Te Kāinga Tawhai was more about the use of less tangible resources such as knowledge and learning rather than physical resources (mean = 1.00).
Brewerton's Forest	The forest-holder is a signatory to the Tasman Forest Accord which removes their right to harvest indigenous timber. Non-harvest is used as an offset and allows the forest-holder to meet obligations under their FSC certification (mean = 0.50).

6.8 Rūaumoko

Rūaumoko is the unborn, the Atua of earthquakes and geological phenomena. Below is a summary of the quantitative data (Figure 15) and qualitative data (Tables 37 and 38) collected at the three study forests for the two tohu that were developed, tested and validated within his domain. Generally the health of the two tohu within the domain of Rūaumoko for the three forests is reasonably positive with the exception of Hine-one of soil condition for Brewerton's forest.

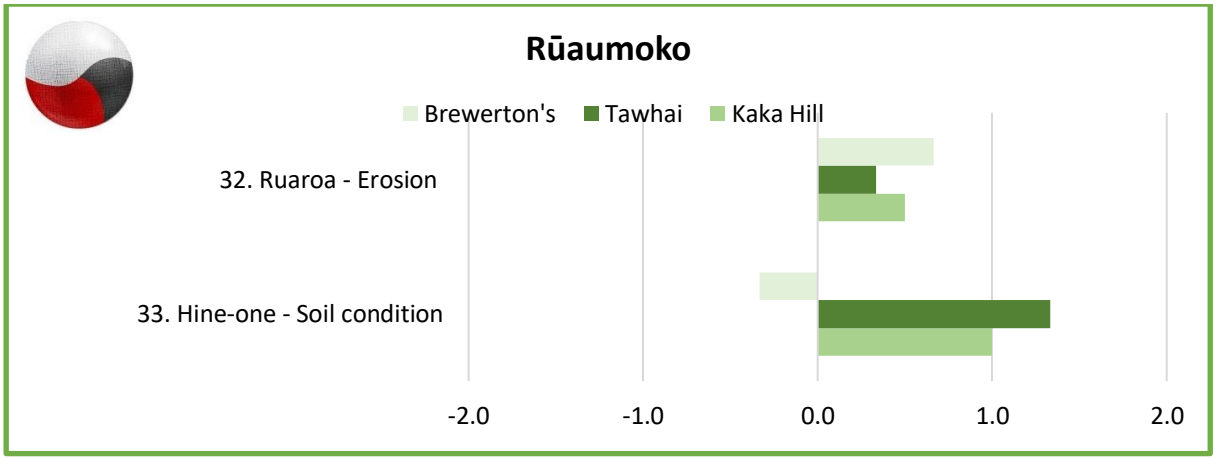


Figure 15: Chart of the mean kaitiaki scores for the three forests for each tohu within the domain of Rūaumoko (Likert scale where -2 is mauri is in worst state of health and +2 is in best state. Scores for all tohu are the mean values assigned by kaitiaki (n=3)).

6.8.1 Ruaroa of erosion

The mean scores for the three sites for Ruaroa are somewhat counterintuitive (Table 37). One would assume that Tawhai would have achieved the highest mean score being in more of a 'natural' state, however it was scored the lowest of the three. Brewerton's, where specific mention of human induced erosion was made, was actually scored the highest. While the differences in the ranking of the three forests is inexplicable all three forests fall within the mean = 0 to 1 range indicating that erosion has not been identified as a problem at any of the three study forests.

Table 37: Comments and scores made by kaitiaki about the Ruaroa of erosion tohu

Kākā Hill	There is evidence of human induced erosion due to a vehicle track though the forest but the effects were described as low. Kaitiaki also observed "slips and snow damage of trees but regeneration is working well" (mean = 0.50).

Te Kāinga Tawhai	Kaitiaki noted very little human induced erosion but did identify some natural erosion (mean = 0.33).
Brewerton's Forest	Kaitiaki highlighted some human induced erosion when passing through the adjacent plantation forest area (mean = 0.67).

6.8.2 Hine-one of soil condition

The mean scores for Hine-one were found to match the soil types from loam to clay as per S-map Online (Manaaki Whenua Landcare Research 2017). Accordingly Brewerton's Forest soil type is predominantly clay[128] (mean = -0.33), Te Kāinga Tawhai predominately loam[129] (Mean = 1.33) and Kākā Hill a mix of the two[130] (mean = 1.00) (Table 38).

Table 38: Comments and scores made by kaitiaki about the Hine-one of soil condition tohu

Kākā Hill	"Fertile, clay mix, healthy, stony," and "hapū with option to grow more fertile forest" (mean = 1.00).
Te Kāinga Tawhai	JK wrote that "the forest has kept this whenua together" in reference to the forest holding the soil (mean = 1.33).
Brewerton's Forest	"Fertile for naturally grown forest" and "Naturally low in fertility" appear to be at odds with each other (mean = -0.33).

6.9 Mauri/ Wairua

This final tohu, Te Kuwhatawhata is an overall assessment of forest health including mauri (the life force) and of wairua (the spiritual dimension). This tohu is not within the domain of any single domain Atua. Below is a summary of the quantitative data (Figure 16) and qualitative data (Table 39) collected at the three study forests for Te Kuwhatawhata tohu. All three forests received positive responses and relatively high mean scores for Te Kuwhatawhata (Table 39).

[128] 100% Donald: shallow, well drained clay
[129] 100% Baton: moderately deep to deep, imperfectly drained, loam
[130] 90% Donald: shallow, well drained, clay, 10% Hope: very shallow, well drained loam

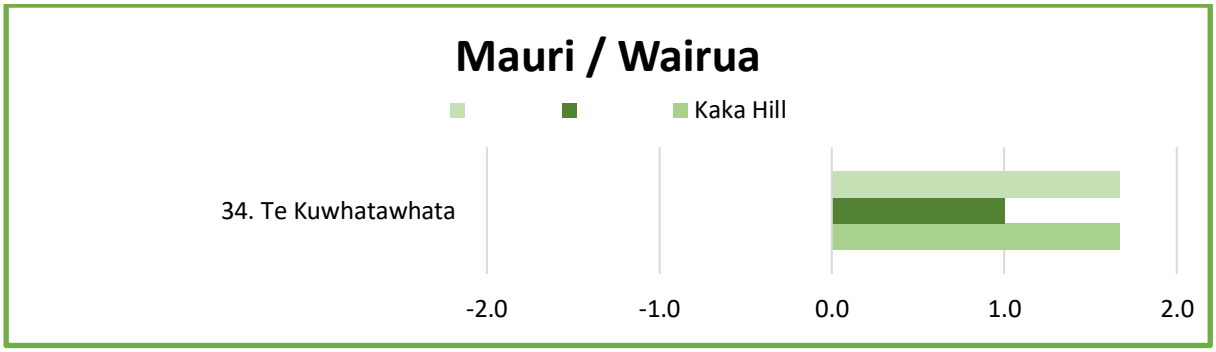


Figure 16: Chart of the mean kaitiaki scores for the three forests within the Te Kuwhatawhata tohu (Likert scale where -2 represents the poorest state of health and +2 the best state. Scores are the mean values assigned by kaitiaki (n = 3)).

While Brewerton's received the lowest score (mean = 1.17) of the three forests it still fell within the top quarter of the scale (Q4) (Table 39). Te Kāinga Tawhai received the highest mean score possible (mean = 2.00). This implies that no interventions could be made by the forest-holders to improve the health of the forest, which is probably not true, so is probably over scored. However, the relative feelings about the three forests hold true.

Table 39: Comments and scores made by kaitiaki about Te Kuwhatawhata

MAURI/ WAIRUA	
34 Te Kuwhatawhata	
Kākā Hill	Maui wrote "Awesome, have filled my wairua while being here" (mean = 1.67).
Te Kāinga Tawhai	"Tino pai te mahi o enei kaitiaki[131]". At Te Kāinga Tawhai all kaitiaki gave the tohu the top score of 2 (mean = 2.00).
Brewerton's Forest	"Good feeling in puku." "Feeling is good, but feels like a newish forest" (mean = 1.17).

[131] Great work on the part of the forest-holders (who are referred to here as kaitiaki or guardians)

6.10 Forest assessments by Atua

In this section the results of the forest assessments are collated and presented by Atua domain through both qualitative and quantitative lenses. A Box-and-Whisker Plot was used to analyse the distribution, or spread, of the mean values for each tohu relative to the other tohu within that Atua domain. It was also used as to visualise trends between different forests that were assessed (Figure 17). The health status of the tohu are grouped according to five band widths. Each band is composed of a qualitative statement, a range of mean Likert scores and is colour-coded from light green to dark green to facilitate different ways of knowing. The bands are very poor (-2 to -1.2); poor (<-1.2 to -0.4); moderate (>-0.4 and <0.4); good (0.4 to <1.2); and very good (1.2 to 2). This provides an overall picture of the quantitative data sets (see Appendix 4 for the Likert mean scores and range of scores for each of the three forest assessed).

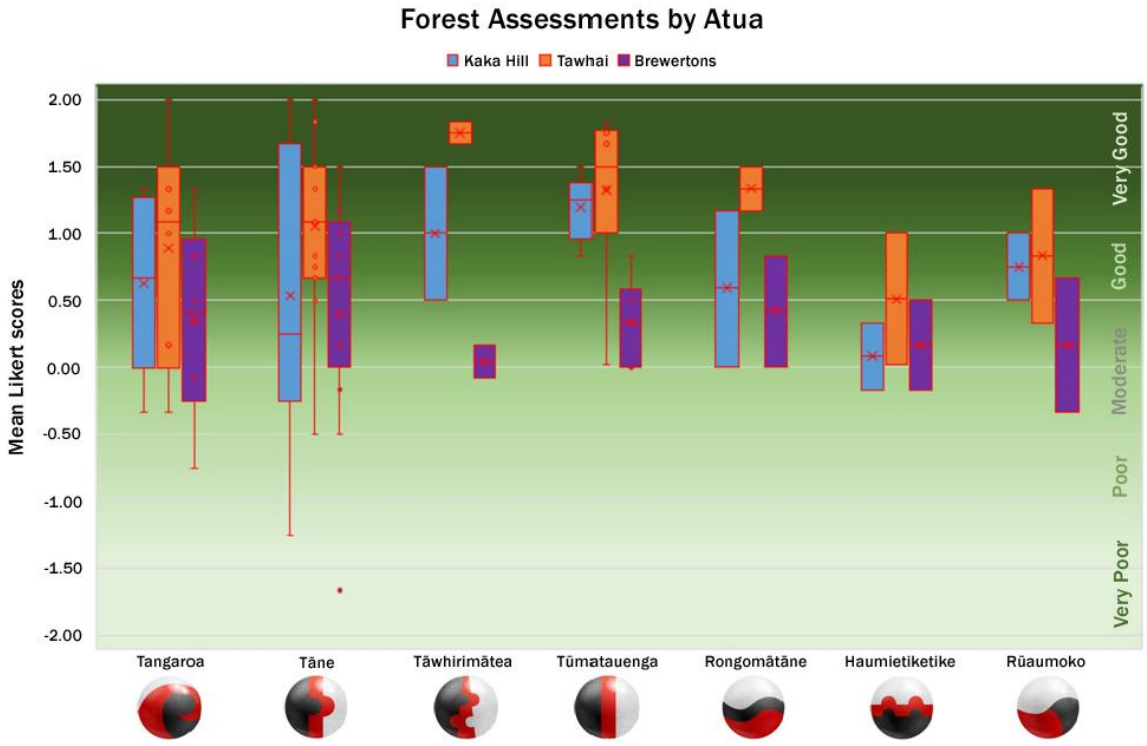


Figure 17: Box-and-Whisker Plot of the forest assessments by Atua based on the mean Likert scores for each of the three study forests. The x within each box indicates the mean score and the line the median score for each Atua group of tohu.

Tangaroa. The median scores in the Tangaroa kete of oceans and inland waterways all fall within the 'good' band (i.e. 0.4 to 1.2) for the three forests. Tūtewehiwehi was scored lowest of the tohu at all three forest visits (-0.75, -0.33, -0.33). These scores reflected the lack of observations by kaitiaki of reptiles as well as the lack of knowledge on the part of the forest-holders about the status of reptiles in their forests. Even though this lack of knowledge served

to lower the median scores for all three forests the status of their tohu were still mainly 'good' with some tohu 'very good'.

At Te Kāinga Tawhai the scores across the kete had a wide spread from -0.33 to 2.0 in comparison to much of the data set. This in part can be explained by a lack of knowledge on the part of the forest-holders about the state of Tūtewehiwehi, as above. It can also be explained due to kaitiaki at times scoring the state of the stream as observed and sometimes scoring the state of the stream based on its 'usual state' as told by the forest holder. At Brewerton's Forest there was also ambiguity and uncertainty on the part of kaitiaki on how to score the kete. Upstream from the ford where the assessment of this kete took place the water was 'crystal clear' and on the downstream side 'murky green' (range = -0.75 to 1.33). A related phenomenon was observed at Kākā Hill where one kaitiaki assessed a longer stretch, including a less healthy stretch, of the stream than the others.

Tāne. The mean scores for the three forests concerning issues of forests and birds are all within the 'good' band, with Takapua of canopy trees being rated 'very good' across all three counterpart forests. Kākā Hill scored the maximum (mean = 2.0) for two tohu (Takapua of canopy trees and Rurutangiakau of regeneration) and Tawhai scored the maximum for Te Kuwhatawhata of bush size and shape (mean = 2.0), the latter linked to being ecologically part of an adjacent Kahurangi National Park ecosystem. The results for Kākā Hill are interesting, with an obvious split between flora and fauna associated tohu. While the median score was 0.25 (i.e. in the 'good' band), and four tohu in the 'very' good band most of the tohu associated with birds are found below the median. The overall health status of Kākā Hill was particularly negatively affected by the poor status of Haere-awaawa of ground birds (mean = -1.25). This represents the widest spread of scores of the entire data set. The health status for Tawhai and Brewerton's were both also negatively affected by the status of Haere-awaawa at their respective forests, with this tohu being scored the lowest for Tawhai (mean = -0.50) across this kete. The lack of observations and forest holder knowledge of ground birds at both Kākā Hill and Tawhai influenced these scores. Brewerton's score (mean = -0.17) was tempered somewhat compared to the counterpart forests by the fact that two ground birds were observed outside of the forest and duly noted by kaitiaki.

The outlier, Rerenoa (mean score -1.67), at Brewerton's appears to be a function of observations and conversations of mistletoe and rata at the first two forest visits and expectations not being met at Brewerton's. Comments by kaitiaki that, while no climbing plants were seen, they were sure that they would find some if they spent more time looking suggests that the outlier is indeed underscored.

Tāwhirimātea. The health status of the two Tāwhirimātea tohu are quite different across the three forests with each falling in a different band. For Tawhai both tohu are 'very good', for Kākā Hill one tohu is 'good' and the other 'very good' and for Brewerton's both tohu are 'moderate'. There is a relatively wide gap between the two Kākā Hill tohu (Piro of smell of the forest (mean = 1.5) and Tānerore of weather and climate (mean = 0.5).

Tūmatauenga. For both Kākā Hill and Tawhai the political and social issues within the kete of Tūmatauenga are 'very good'. The guardian of the economic tohu Tu-ringa-raupa restrained the median at Tawhai (mean = 0). While the score reflected a low economic return from the forest, kaitiaki commented on the educational and restoration benefits of the forest being of a higher priority at the forest than the ability of the forest to pay for itself. The median score for Brewerton's falls just below the 'good' band width at mean = 0.33. Kaitiaki generally felt that the current management of Brewerton's was sound but were both enthusiastic and apprehensive about the transfer of the landholding into iwi hands post recent Treaty of Waitangi settlements in the region.

Rongomātāne. Tawhai was rated 'very good' for both the tohu ki Rongomātāne of Wainui (mean = 1.5) and Uepoto (mean = 1.17) with healthy relationships with surrounding land use and good stocks of rongoā. Kākā Hill and Brewerton's rated 'good' on one tohu and 'very good' on the opposite other.

Haumietiketike. The median scores for all three forests around wild foods and mahinga kai were within 0.5 of a Likert point of each other and around the boundary between the 'moderate' and 'good' status zones. Tawhai performed better than its counterparts as its rights around harvest had been established (in this case the right not to harvest, Patekateka mean = 0.0) and the forest-holders were actively practicing this right (Rua-pupuke mean = 1.0). Kākā Hill and Brewerton's rated 'moderate' on one tohu and 'good' the opposite other. For Brewerton's the right to not harvest has been established (Rua-te-pupuke mean = 0.5) but this right was not seen to be actively practiced (Patekateka mean = -0.17). For Kākā Hill the harvest of mahinga kai, in the form of wood products, was occasionally practiced (Patekateka mean = 0.33) but was hindered because harvest rights had yet to be secured (Rua-te-pupuke mean = -0.17).

Rūaumoko. The scores within the kete of Rūaumoko accurately reflect the kōrero. Both Kākā Hill and Tawhai were in the 'good' zone for the two tohu represented by the stability of soils and gravels in the respective forests (Kākā Hill median = 0.75, Tawhai median = 0.83). Brewerton's score (median = 0.17) was lessened due to the exposed roads through, and skid sites adjacent to, the forest but its overall health status is still rated as 'moderate'.

Mauri and Wairua. All forests were assessed as having good cultural health with strongest (Te Kāinga Tawhai), stronger (Kākā Hill) and strong (Brewerton's forest) mauri. The tohu of Te Kuwhatawhata which is an overall assessment made by kaitiaki of the health status of the mauri and wairua of the forest following an assessment of all the other tohu (Brewerton's mean = 1.17; Kākā Hill mean = 1.67; Tawhai mean = 2.00). This ranking aligns with the number of tohu in the 'very good' zone for each of the three forests (Brewerton's 2 times; Kākā Hill 11 times; Tawhai 18 times) and the highest or highest equal mean scores across the 34 tohu the greatest number of times (Brewerton's 3 times; Kākā Hill 8 times; and Tawhai 25 times).

6.12 Key findings

Eleven key findings related to the development of the Ketewhaihua were identified, these being:

1. A strong correlation between the kōrero documented and scores made by kaitiaki with the relative state of cultural health of the three 'hinterland' forests assessed.
2. Each kaitiaki brings their own set of values and biases to forest assessments based on their life, work experiences and practice of kaitiakitanga. They also bring the aspirations of their iwi and hapū. These values were reflected in their kōrero and in their scores.
3. Comments and scores made by kaitiaki included actual observations of species and phenomena but were not restricted to these, including the potential for species to exist. A species or phenomenon may not be currently known from a site. However, if habitat or other conditions are favourable for that species or phenomenon then this has greater potential for a species to exist than if the habitat conditions are not favourable.
4. The levels of traditional and contemporary mātauranga Māori that kaitiaki individually and collectively brings affects assessments. High levels of mātauranga positively affect scores and conversely low levels attract low scores.
5. Forest-holders' level of knowledge about their forest can affect assessments. As with the level of mātauranga held by kaitiaki, high levels of forest holder's knowledge about their forest positively influence scores. And conversely low levels attract low scores. Forest owners can influence the scoring moving from current state (as observed) to an average state of tohu (e.g. "The river is currently in flood, usually it's more like this").
6. Expectations, on the part of kaitiaki, not being met can affect assessments. At Kākā Hill, expectations were built up by the forest-holder in describing a one-off event where 20 kākā were once seen in a single flock. During their visit only two kākā were observed. While this was probably typical of a one-day visit to Kākā Hill, the hype appeared to supress the scores and comments made by kaitiaki for *Tūmataika* of 'Forest kaitiaki'.

7. Different individuals have different spatial awareness. There was sometimes difficulty in collectively, as the whole research team, defining the spatial extent over which to assess some tohu, e.g. the extent of 'a forest', the stretch of a stream and, the boundaries of sub-catchment or catchment.
8. The lack of differentiation by kaitiaki between native and exotic species was surprising and potentially problematic. For example, at Brewerton's there was an abundance of both exotic wasps and exotic passerines. While the comments by the kaitiaki tend to be negative for the Punga of insects and Tāne-te-hokahoka of small birds tohu the scores were positive. On the one-hand this could be seen as a negative, e.g., impact to native species, annoyance factor for humans, but on the other-hand it could be seen as the bountifulness of the forest ecosystem in supporting the introduced species. The question though is whether their presence is at the detriment of other species.
9. Comments and/or scores for some tohu were not always updated to reflect later observations. This was most obvious with birds, which may reveal themselves at times post the forest walk and interviews with landholders.
10. For the most part there was a logic to the scores and comments made by kaitiaki. However, assessments of a few tohu were inexplicable, counterintuitive or at least not readily explained. One obvious example was that of Ruaroa of erosion. Logically one would have expected Te Kāinga Tawhai to score the highest because of the three forests it is the least developed e.g. it has no roads through it. Similarly Brewerton's should have been scored the lowest because of the forestry activities directly adjacent and the roads which bisect it. However, the opposite occurred with Brewerton's the top scorer and Te Kāinga Tawhai at the bottom.
11. Over the course of development of the suite of tohu there was increasing consensus between kaitiaki as they became familiar with how to rate the health of tohu and use the Ketewhaihua. As the tool was developed their scores became more aligned with their kōrero.

Chapter 7

Discussion

7.1 Introduction

Māori are increasingly being asked to articulate their cultural values in relation to the management of natural resources. This is due to greater assertion of their rights guaranteed under the Treaty of Waitangi as well as greater acknowledgement by wider society of Māori ways of knowing. Māori concepts and approaches are increasingly accepted by government authorities and scientific communities (Harmsworth & Awatere 2013; Harmsworth, Awatere & Robb 2016). Indigenous People's worldviews are recognised as being holistic, integrated and connected, with the inclusion of Indigenous worldviews in environmental management leading to improved outcomes (Berkes 1999; Marsden & Royal 2003; Moller *et al.* 2004; Miller 2005; Berkes 2009; Jurney & Hoagland 2015). It is often difficult for Indigenous Peoples to express their cultural values. Cultural values are inherent, they are akin to one's own accent. It is often difficult for people to recognise these values in themselves, let alone provide answers when questioned about these values that are coherent across cultural spaces. Culturally-based approaches to monitoring can bridge this gap and assist cross-cultural communication. They help to frame discussions in ways that are mutually recognisable and complementary across worldviews, where one worldview is not viewed as superior to the other. To be effective they also need to be generally understandable to science and the wider public. Internationally, current forest assessment techniques focus on biodiversity protection or resource assessment issues. However, this is only part of the conversation in terms of what constitutes 'forest health', at least from an Indigenous perspective. The Ketewhaihua developed through this research contains tohu of forest health as well as human relationships with the forest around water, wild foods, agriculture, geography, climate, and the socio-political sphere. This research has produced learnings both from the process of developing the Ketewhaihua as well as of the utility of the toolkit. The ideas developed in this thesis provide for improved methodology and practice to CBM approaches.

In this chapter the research questions are addressed through three key areas of discussion:

1. The validity of the Ketewhaihua as a credible culturally-based monitoring tool
2. Considerations in regard to the implementation of the Ketewhaihua
3. Wider implications of the research

7.2 The validity of the Ketewhaihua as a culturally-based monitoring tool

I contended that there are three key ingredients for co-creating a valid and credible CBM tool. These are; 1) an appropriate co-researcher engagement methodology; 2) a culturally relevant framework and suite of tohu; and 3) an appropriate method and metric to gather information about those tohu. To date few researchers have brought these together in their CBM work. This research has achieved this. In this section these three key components are discussed, and in the process validate the research and the Ketewhaihua as a useful CBM tool.

7.2.1 An appropriate co-researcher engagement methodology

In Aotearoa New Zealand the theory, ethics and principles of kaupapa Māori provide good guidance on how to engage, proceed and reflect on research practice. Engagement methodologies between Indigenous groups and scientists are however, rarely documented. The engagement framework in this research was not explicit from the outset but was developed over the first year of the project (see Chapter 4, Section 4.2 *Co-researcher engagement methodology*). It helped build trust and provided a measure of cultural safety for the participants. The methodology was appropriate to this research. Every project is different, with different characters in different contexts, so to an extent every Indigenous People's – Western science research collaboration will need an engagement methodology that is tailored to each unique context. However, three points that are relevant across research collaborations are initiation, relationship building and evaluation of practice.

The critical role of participants in the initiation of Kaupapa Māori research has been emphasised (Bishop 1996; Harmsworth 2005). Creating conditions for engagement can be difficult because of the cultural distance between the 'flax-roots', those people on the ground with research needs and cultural knowledge, and scientists and institutions who have scientific knowledge and skills but also institutional capacity to deliver – both in terms of process and outcomes. In this research, the principal researcher was already immersed in the Māori community, through his involvement in a large government funded research programme called the Motueka Integrated Catchment Management programme. Importantly the principal researcher was present when tangata whenua expressed their research needs – which included the development of a forest monitoring tool. However, this is not a typical situation. While initiation by the people on the ground directly to scientists is preferable, this is often difficult to bring about because of numerous challenges including, capacity to engage, a lack of knowledge of who to engage with and funding mechanisms to support 'flax-roots' issues, and the cultural and often other distances between the parties. One suggestion involves a platform whereby the 'flax-roots' and scientists can bring 'fuzzy' ideas which are then co-developed through iterations into a more concrete idea with clearer research questions

and methodology (after Dick 1993). However, this approach may not be so attractive to research funders who adhere to restrictive timeframes that don't allow, or fund, pre-application engagement and emphasise identifiable and measurable outputs whereas kaupapa Māori emphasises the importance of the process.

Harmsworth (2001) identified relationship building as a key factor for a successful collaborative research model. Trust and relationship building with the principal researcher and kaitiaki stretched back ten years prior to his engagement in this research. Such a level of immersion is rare. A formal engagement framework and methodology was required due to Lincoln University being involved in the research relationship. Memorandum of agreements (MoA) and communication protocols formalised the tripartite relationship. Mutual expectations agreements were also developed between the principal researcher and the supervisors. Approval was successfully granted through the Lincoln University Human Ethics Committee. Four kaitiaki were mandated by their iwi to join the research team as co-researchers alongside the principal researcher (Figure 5). This work was carried out over the first year of the project. One of the iwi decided not to sign a MoA, despite being heavily involved in the design of the agreement because of its tripartite nature but were still happy to mandate a kaitiaki to the research team.

A natural alignment between both kaupapa Māori and action research has been identified (Kahakalau 2004; O'Reilly 2010; Cram 2011). Practitioners of both kaupapa Māori and action research stress the importance of being reflexive and evaluating collaborative projects (Lincoln & Guba 1985; Bishop 1996; Harmsworth 2001,2005; Cram 2016; Bradbury *et al.* 2017; Carlson, Moewaka Barnes & McCreanor 2017). None have suggested a convergent evaluation methodology to evaluate the rigour and trustworthiness of research practice from these two perspectives. Five evaluation criteria from the IBRLA framework developed by Bishop (1996) for kaupapa Māori and four offered by Lincoln and Guba (1985) for action research were uniquely utilised to evaluate the success of the research. The research practice was shown to have been met with success across the nine kaupapa Māori – action research evaluation criteria (Chapter 5, Section 5.7).

7.2.2 An appropriate culturally-based framework and suite of tohu

In this research a cosmological Atua framework that was already familiar to the Māori co-researchers was utilised to help derive and structure a suite of 34 culturally-based tohu around the first seven sons of Papatūānuku and Ranginui (the domain Atua). Such an Atua framework is used for resource management purposes including iwi management planning (Passl 2004) and environmental monitoring (Walker 2009; Harmsworth *et al.* 2011). The research provided the opportunity to

develop the Atua framework further including a deeper understanding of Māori taxonomic systems involving complex whakapapa connecting deities with humans, flora, fauna, minerals and phenomena. As a graphic (Figure 8) the Atua framework reaches across a range of learning styles and assists the visualisation of a holistic system of human-nature interrelationships.

7.2.3 An appropriate approach to gathering data

A mixed methods approach is common practice in CBM where both qualitative and quantitative information is gathered. However, there is a propensity to place primary importance on quantitative data. In all cases cited in Aotearoa New Zealand those undertaking the assessment are required to first score a tohu numerically on this state. This is followed by the assessor making supporting comments on its state of health. With such a 'numbers driven' approach it is contended that assessors will be tempted to make comments to justify their score. Using a 'kōrero driven' method, as trialled in this research, qualitative data are recorded for each tohu first. Then, following comments made, the state of health of the tohu is rated numerically. This order is seen as important because it is more insightful to have robust discussions about the health of each tohu first, with the numbers supporting the discussion rather than having the scores drive the discussion.

Recording qualitative data often presents challenges. While this data is often 'rich' it can also be 'bulky' and difficult to manage. Knowing what is relevant and deciding what to keep or discard can be challenging. In this research brief poetic narratives were favoured as culturally-appropriate and efficient methods for distilling the essence of the state of health of tohu. This was met with mixed success. In an exemplar, John Katene summarised the health of Parauri of the nectar feeding birds in Moss Reserve (V6) as "Tūī singing in the background 'Song full of honey' - *Tangi taiawhio te rongo koro tūī - 'Rongo reka rawa'*". His whakatauākī indicates that tūī are present in numbers and the food supplies are good but not overly abundant. The proficiency of kaitiaki at condensing their observations and ways of knowing in such a way varied between them, however this will probably improve given further experience and application of the Ketewhaihua by them.

Most CBM tools rely on the use of quantitative data in whole or part, but its collection can also be problematic. It can be seen as a reductionist approach, reducing cultural values to digits, and removing the cultural context from the process which can mean a loss of meaning. It could be argued that quantitative data is not actually needed, if good qualitative data is gathered, because the meaning is held within the kōrero and comments which do not need interpretation. Despite less importance being placed on the quantitative data it still was found to have its uses. Its utility was twofold. Firstly, quantitative data provides an overall picture of forest health. The Box-and-Whisker Plot was a useful way to illustrate this with tohu grouped by the seven Atua enabling the

comparisons between the three forests (Figure 17). In longitudinal assessments the Box-and-Whisker Plot would be a good method to highlight which Atua were performing better and which ones were performing poorer over time. In applied situations, high scores will be a source of commendations on good practice and low scores a source of recommended interventions to improve forest health. The rationale for these commendations and recommendations can be sourced in the qualitative data.

Secondly, through triangulation with the qualitative data, the quantitative data can be used to monitor the individual and collective understanding of tohu. It was found during the development of the prototype tool that occasionally there were quite large variances in understandings between kaitiaki of particular tohu and how to score them. These were readily highlighted through cross-checking the two data sets. Sometimes a kaitiaki's score did not match their kōrero, other times one kaitiaki's score was widely different to the others although their kōrero was shared and similar. Once these anomalies were identified information sharing and discussions took place and interventions were introduced in order that in subsequent rounds the scores for that tohu better matched the kōrero, and the collective understanding of the tohu and the reliability of the data improved.

This research involved semi-structured interviews of forest-holders carried out by kaitiaki utilising the Ketewhaihua as a guide. This is a novel approach, not only in Aotearoa New Zealand but also internationally. The usual practice is for Indigenous monitors to act as impartial observers noting their observations in much the same way as scientific observers. Here kaitiaki instead interviewed forest-holders, kanohi ki te kanohi – face to face. This was an appropriate method, both as an acknowledgement of the guardianship role of the forest-holders as well as providing an opportunity for the sharing of knowledge.

Issues identified that may bring into question the utility and reliability of such an approach include varying levels of mātauranga Māori amongst kaitiaki, outside influences on kaitiaki (in this case the influence of forest-holders), the degree to which the potential of mauri is taken into account, variations in the spatial and conceptual understanding between kaitiaki, kaitiaki expectations of tohu health being met (or not), different perceptions of the impact of naturalised or invasive species, and differences between kaitiaki in fully completing their data sheets to reflect changes in the status of tohu throughout the day. These issues are likely not limited to the Ketewhaihua but probably also affect the results of other CBM tools incorporating quantitative approaches, however, these are rarely discussed in the literature. Though with training and increased familiarity with the Ketewhaihua and calibration of the tool, particularly with the same team, these issues can be addressed and in turn can improve the robustness and reliability of the data.

7.2.4 An appropriate metric for measuring cultural values

The selection of an appropriate metric for measuring cultural values has been identified as being crucial in this type of research particularly where intangibles are involved (Satterfield *et al.* 2013). There was nothing in the literature reviewed that discussed the cultural appropriateness of different types of metric for CBM either in Aotearoa New Zealand or internationally. In Aotearoa New Zealand two models of the Likert scale are typically used with CBM approaches, a 1 to 5 scale (e.g. Tipa & Teirney 2003), and a -2 to +2 scale (e.g. Morgan 2013). Following the trialling of both types of metric, a -2 to +2 scale was favoured by kaitiaki involved in this research. They found it more accurately reflected the important concepts of mauri and wairua. They also found it easy to visualise where the half-way mark lies. The metric later incorporated adjectives describing points along the scale for each tohu as a semantic differential scale. Occasionally kaitiaki scored half-points, citing difficulty in assigning whole numbers to the health of some tohu. In the development of a potential field survey approach to monitoring forest health, Lyver *et al.* (2017) used variable metrics depending on the indicator being assessed (e.g., *The language or sound of the river* indicator is assessed on a 4-point scale and *The abundance of fruit on the trees in the forest* is assessed on an 8-point scale). A variable scale, as advocated by Lyver *et al.* (2017), may present difficulties in the ability of kaitiaki to consistently rate some tohu or make comparisons between the health of different tohu. It is suggested that a standardised 7-point Likert (-3 to +3) with variable descriptors along the continuum would make it easier for kaitiaki to score and undertake comparative analysis between the health of tohu.

7.3 Considerations in regard to the implementation of the Ketewhaihua

The fully developed Ketewhaihua was found to provide a holistic assessment and be an effective tool at collecting information about the state of health of indigenous forests from a complementary kaupapa Māori-Western science perspective. Although the three forests assessed had quite similar biological characteristics, being old-growth 'hinterland' forests, the tool was able to be used to readily differentiate between their states of health and rank them accordingly. Information gathered included not only biological aspects, normally associated with other types of environmental monitoring, but also information around human interrelationships with forests. The results were able to comprehended and successfully presented by the principal researcher through both qualitative and quantitative lenses, which for the most part were in alignment and complemented each other.

When using the Ketewhaihua there are particular considerations that new users need to be cognisant of when applying it to assessments. Some of these may also be of relevance to other CBM or citizen science tools. They are; (i) tool modification; (ii) Kaitiaki bias; (iii) tool calibration; (vi) mātauranga Māori; and (v) forest holder interviews. Each of these issues will need to be discussed and a plan of action developed on how they will be addressed.

7.3.1 Tool modification

Modification or adaption of CBM tools to suit different tribal contexts is a common phenomenon in Aotearoa New Zealand (Awatere & Harmsworth 2014). It is also a likely key to their successful transferability. The Ketewhaihua will necessarily be modified to suit the cultural realities of new users of the tool. The appropriateness of the Atua framework will need to be considered, with local names of domain Atua and poutiriao, and their interrelationships and whakapapa confirmed. Following this, suitable whakataukī, mōteatea or other specific tribal narratives need to be identified prior to the tool being tested in the field.

7.3.2 Kaitiaki bias

Kaitiaki are not disconnected objective observers. They bring to forest assessments the aspirations of their iwi, hapū and whānau and therefore bring an element of subjectivity to the process of scoring. To deny or disregard these values impacts on their own mana as well as the mana of their whānau and iwi. Kaitiaki bias is normative for this type of monitoring where subjectivity and bias are openly accepted, traits which are normally to be avoided in research. They were issues which were considered not to be 'resolved', but rather, to be embraced. In this research some kaitiaki held strong views, usually confined to one Atua to which they have a particular affinity with. They consistently scored the lowest or equal to the lowest across the set of tohu within the kete of that Atua regardless of the forest. However, these views were invariably moderated by others. If all kaitiaki hold strong views then the issue highlighted must be important and needs to be addressed.

7.3.3 Tool calibration

The Ketewhaihua will need to be calibrated to new users undertaking forest assessments to increase its utility, accuracy and effectiveness. In this research the tool was deemed to be calibrated once consensus was reached for each of the tohu. Consensus was not absolute (i.e. scores being exactly the same for each kaitiaki) but a 1-point range from the highest to lowest score on a five-point Likert scale for each tohu was generally considered acceptable. To reach this point four main calibration issues need to be discussed amongst the monitoring group and agreement reached on how these will be addressed. These include; (i) the spatial extent over which each tohu is assessed; (ii) kaitiaki

expectations being met or not met; (iii) differing perceptions of the impact of naturalised species on forests; and (iv) the updating (or not) of comments or scores to reflect later observations. Over time these issues will decrease as kaitiaki become more familiar with the use of the toolkit and how to assess the health of tohu. Calibration of the tool will be assisted by consistently using the same team members in monitoring programmes however, this would need to be balanced against the benefits of including other whānau members and opportunities for learning and the intergenerational transfer of mātauranga Māori.

7.3.4 Mātauranga Māori

Kaitiaki on the research team held a variety of levels and types of individual and collective knowledge, developed through their lived experiences and their praxis as kaitiaki. They spoke of wearing multiple hats – always the learner, sometimes the expert. Kaitiaki felt that their individual level of knowledge was relatively low, however they expressed surprise at the breadth and depth of mātauranga amongst the collective group. This is an important consideration for establishing a monitoring team – not everyone has to be well versed in traditional knowledge but key was a collective commitment to share and learn. Where knowledge was lacking in a particular area, guest kaitiaki were seconded to the team to share their expertise and participate in the passing of knowledge between generations. The level of mātauranga Māori in a team can influence the results. Low levels of mātauranga about a tohu tend to result in low scores. This is likely to be more marked in initial assessments undertaken by inexperienced monitors. However, as the level of knowledge amongst a group grows then the accuracy of the assessment should also increase.

7.3.5 Forest holder interviews

The level of forest holder's knowledge about their forests and the connections they have to their forests affect the way kaitiaki score. Good forest holder knowledge about a tohu tends to result in a higher score than poor knowledge about a tohu. This is an interesting phenomenon that is probably common to this type of monitoring. While increasing knowledge on the part of both kaitiaki and forest-holders does not increase the biological health of the forest, per se, it does increase the potential for positive change. Forest holder influence imparting bias on the scores can be seen problematic. However, it can also be seen as leading to a more accurate assessment of the 'usual state' of the forest than those carried on a single day which may be skewed by abnormal events. Taking forest-holders views into account, rather than to seek objectivity is normative for this approach.

7.4 Wider implications of the research

This research adds to the body of knowledge around culturally-based monitoring, as well as aligned research areas such as community-based monitoring and citizen science. The wider implications of this research are briefly discussed below under three themes; frameworks and tohu, the practice of culturally-based monitoring, and policy initiatives.

7.4.1 Frameworks and tohu

The formal assessment of indigenous forest health by Indigenous people around the world is growing, however Indigenous peoples invariably continue to rely on approaches underpinned by Western ways of creating knowledge. Internationally the use of criteria and indicator (C&I) frameworks with tohu arranged and analysed in standard cohorts such as environmental, economic, social and political dimensions are the most common approaches (e.g. Karjala, Sherry & Dewhurst 2003; Sherry *et al.* 2005; Garcia & Lescuyer 2008; Saint-Arnaud *et al.* 2009). Problems have been identified with the durability of C&I type monitoring systems, which in many cases cease or there is a significant decrease in activity once external funding ceases (Garcia & Lescuyer 2008). Less common are the use of explicit Indigenous frameworks to underpin monitoring tools or programmes, though examples do exist (e.g. Shearer, Peters & Davidson-Hunt 2009; Harmsworth *et al.* 2011). It is argued that tools and programmes that are underpinned by Indigenous frameworks, such as that presented in this research, where Indigenous peoples can easily connect with frameworks developed by themselves and reflect their aspirations, will be more lasting and effective.

Research on the identification of culturally-based tohu is widespread, both in Aotearoa New Zealand and internationally. However, the development of workable field tools for the collection of data is much less common. The Tangata Whenua Roopu (TWR) working on the Kauri Dieback Programme identified 44 possible cultural indicators to help inform management of the disease with most of the indicators falling within the domain of Tāne (Shortland 2011b). The Atua framework, developed as part of this research, was reviewed by the TWR at a presentation by the author (6th September, 2013) as well as a review of literature related to this research (Walker 2012; Walker *et al.* 2013). The Atua framework assisted the TWR to develop their own hybrid Atua – tikanga values framework incorporating, in particular Tūmatauenga (human influence at the site) and Tāwhirimātea (air needed and acquired), to widen the range of indicators and capture human induced pressures (Chetham & Shortland 2013). A Kauri Ngahere Cultural Indicators Record Form – Version 1.0 was also developed as part of the same research project and has since been tested in the field as part of an initial pilot wānanga (Shortland 2017).

In another project, Tūhoe Tuawhenua Trust elders (an Ahuwhenua Māori Land Trust located in Te Urewera) identified 57 'interview based' indicators and 49 'field survey' indicators for their mixed hardwood – podocarp forests (Lyver *et al.* 2017). From the field survey indicators, 25 priority indicators, grouped according to five culturally-relevant themes (i) procurement of food, (ii) natural productivity, (iii) nature of water, (iv) nature of the forest, and (v) spiritual dimension, were used to form a field survey approach using a Likert scoring system. The themes match the Atua domains of Haumietiketike, Tāne, Rongomātāne, Tangaroa and the non-aligned Mauri – Wairua tohu. No field survey indicators for Tūmatauenga, Tāwhirimātea, Rūaumoko were identified, although interview based indicators were identified for Tūmatauenga. An oversight here perhaps is the lack of tohu related to climate change. The application of an Atua framework here could have strengthened the survey approach developed by Lyver *et al.* (2017).

7.4.2 The practice of culturally-based monitoring

Currently there is a variety of CBM tools available in Aotearoa New Zealand for monitoring the state of health of the environment from an Indigenous Māori perspective, mainly within the domain of Tangaroa. There has been some other work on the development of tohu for indigenous forests (Shortland 2011b; Lyver *et al.* 2017; Lyver *et al.* 2018) but as yet there are no published tools. In the research undertaken by Lyver *et al.* (2018), 19 elders hiked in small groups through five selected tracts of forest to undertake forest assessments using a field survey method developed to first score the health of community-based forest indicators from memory of historic baselines, then used the same indicators to assess the state of health along five selected tracts in two forests. Ngāi Tūhoe are recognised as having strong links and a high level of mātauranga Māori in relation to their forests. While this was a sound approach in terms of accessing in-depth mātauranga about indigenous forests, a more typical field exercise is where just a few kaitiaki (plus whānau) are available for assessments, and the level of knowledge amongst the group about indigenous forests is fragmented, as was the context of this research project.

The Ketewhaihua has potential applications for short-term one-off assessments of forest health in a variety of contexts. Another application of the Ketewhaihua could be in monitoring resource consent applications. Often applicants are required by local and regional authorities to consult with iwi groups if their activity is likely to affect the cultural values of Māori. The toolkit will make it easier for Māori to provide information on these values to applicants in cases where indigenous forests could be affected by development activities. Assessments using the Ketewhaihua would be undertaken by kaitiaki pre-, during and post -consent activity to monitor the effects of the development on these forests.

The Ketewhaihua also has potential for longer-term individual forest, regional and national monitoring programmes, although the longitudinal abilities of the toolkit was not tested because of constraints of time and finances. Longer-term applications of the tool will include private and corporate forest-holders wanting to have their forests holistically monitored by Māori to meet sustainable forest management provisions and certification standards. Knowledge gained through wider use of the Ketewhaihua could provide data to assist the government to uphold international commitments on Indigenous perspectives in relation to forests and biodiversity conservation such as the Montréal Protocol and the Convention on Biological Diversity.

Currently forest-holders have a plethora of methods that they can use to monitor individual aspects of their forests (Handford 2000). A few tools exist which attempt to catch a wider breadth of forest health (Handford *et al.* 2004; Janssen 2004), however their focus is on the domain of Tāne (forests and birds) but neglect the relationships with other domains. This research will not only be of interest to Indigenous groups developing CBM tools but will also be of interest to those in the science and citizen science community wishing to adopt a more holistic approach to their forest monitoring.

The Ketewhaihua has been developed by manawhenua ki Motueka for their own use. However, they have indicated a willingness for the Ketewhaihua framework to be used by other Māori groups to populate with their own specific information and knowledge. The toolkit could conceivably be used by non-Māori groups or private forest-holders to monitor their own forest using a holistic methodology to improve forest management outcomes. Manawhenua iwi may not always have appropriate local kaitiaki to undertake monitoring and may wish to contract the work out to other Māori organisations or approved monitors. Memorandums of agreement between manawhenua and those using the Ketewhaihua in their rohe/ takiwā would be necessary to cover issues of representation, legitimacy and accountability.

7.4.3 Policy initiatives

The findings of this research have immediate implications for policy settings, with sufficient current initiatives and legislation in relation to the involvement of Indigenous peoples in indigenous forest monitoring already primed and in place. There are current obligations under international agreements, such as the Convention on Biological Diversity and the Montréal Process, for Aotearoa New Zealand to report on the extent to which Māori aspirations in the management of biodiversity are being met or not. Nationally, the Biodiversity Monitoring and Reporting System (Department of Conservation, 2011), the Environmental Reporting Act (NZ Parliament, 2015), and the National Policy Statement of Indigenous Biodiversity (Biodiversity Collaborative Group 2018) all call for Māori to be consulted about or be involved in biodiversity monitoring. Major policy changes are not necessarily

required to facilitate the implementation of these research findings. However, what is lacking is the development of culturally-based tohu and tools, and long-term monitoring programmes to enable the collection of data for the initiatives outlined. The Ketewhaihua is well-positioned to contribute to culturally-based monitoring.

Chapter 8

Conclusion

Titiro whakamuri, kōkiri whakamua

(Look back and reflect in order to guide your journey ahead)

New Zealand's indigenous forests cover approximately 23% of the total surface area or 6.2 million hectares. Of this Māori hold over 400,000 ha (more than 6% of the total) and some 238,000 ha of planted exotic forests (13% of total exotic forests) (Miller, Dickinson & Reid 2005). New partnerships have been made between Māori entities and government, corporate and private individuals in the management of forests. The rights, roles and responsibilities of Māori as kaitiaki are increasingly being acknowledged in the legal, policy and public spheres meaning that there will be increased demand for kaitiaki to provide environmental and cultural services to a range of forest-holders wanting the health of their forests assessed and monitored by, and in an Indigenous Māori way.

Indigenous forests are complex ecosystems that are interlinked to socio-cultural and economic systems. Therefore, assessing the state of their health is likewise complex. Traditionally Indigenous people monitored the health of their forests using approaches developed on long-term and in-depth relationships predicated on ensuring their continued physical, psychological and spiritual, well-being. Many Indigenous groups still adhere to these principles – particularly those have retained their independence and isolation from Western worldviews and influence. Contemporary Indigenous peoples' forest monitoring programmes invariably use sustainable forest management frameworks grounded in Western perceptions and values, and these are often broad scale so are not particularly suited for the assessment of forest health at a local or forest management unit level. The monitoring tools that are utilised tend to measure a narrow range of environmental or economic factors and rarely acknowledge Indigenous ways of knowing. Most examples of Indigenous people building their own contemporary environmental monitoring tools based on their own worldview can be found in Aotearoa New Zealand. Māori groups have developed culturally-based monitoring tools particularly within the marine and freshwater domains. However, culturally-based environmental monitoring has recently moved into the terrestrial realm, including forests (e.g. Shortland 2011b; Lyver *et al.* 2017; Lyver *et al.* 2018). The research complements this trend and together they offer unique approaches to improving the management of indigenous forests. In this conclusion chapter the key learnings from this research are highlighted under the following thematic sections; (i) the contributions that

this thesis has made to culturally-based monitoring; (ii) the strengths and weaknesses of CBM, drawing upon findings from this research; (iv) current barriers and opportunities for CBM in Aotearoa New Zealand; and (v) recommendations for future research.

8.1 Contributions of this research to culturally-based monitoring systems

This research provides both academic and practical contributions to the current corpus of knowledge on culturally-based monitoring for indigenous forests. A clear opportunity for contributing new knowledge existed for developing and applying culturally-based frameworks, tohu, methods and tools for assessing the health of indigenous forests from an Indigenous Māori perspective. A culturally-based Ketewhaihua monitoring toolkit has been successfully developed which has its foundation in a Māori cosmological framework but draws upon Western scientific traditions, in particular its methodology, to produce a unique tohu and data collection method.

Atua cosmological frameworks have been used in New Zealand, as an alternative to Western sustainability models, to help structure iwi management plans, cultural impact assessments and cultural health monitoring tools. Atua frameworks help to conceptualise a Māori worldview where all things, living and non-living, are connected through supernatural deities, heroic deeds and complex whakapapa interrelationships. The framework presented in this thesis is based around seven domain Atua, each responsible for an environmental domain, along with a network of related tribal Atua, or poutiriao, with more specific guardianship roles over species and phenomena. The methodology makes use of a set of 34 tohu each linked to a poutiriao and a relevant whakataukī. These and the Atua framework creates a link to the wisdom of the ancestors, helps generate discussion, is flexible, open to interpretation, and creates opportunities for different ways of learning and sharing information amongst whānau and iwi. This is a novel approach in terms of the application of a contemporary Atua framework.

Typically in New Zealand mixed-methods approaches are utilised in the collection of data with both quantitative and qualitative data being collected in culturally based assessments (Harmsworth 2002a; Tipa & Teirney 2006b; Walker 2009; Harmsworth *et al.* 2011). Two unique aspects of this research involved the method in which data was collected. Firstly, the approach taken was 'kōrero driven', in that qualitative data took priority over the quantitative data. In all of the other approaches uncovered, kaitiaki numerically rate the health of tohu first, then they follow this with a qualitative statement. These approaches run the risk of being 'numbers driven', in that the kaitiaki undertaking the assessment seek to justify the score that they have made and risk a loss of meaning. Secondly, brief poetic narratives such as whakatauākī and mōteatea were favoured as culturally

appropriate and efficient ways to record the kōrero and distil the essence of the health of each tohu. Both approaches are novel ways to collect data.

When quantitative data is collected in Aotearoa New Zealand using a CBM approach, typically a 1 to 5 Likert scale is utilised to rate the health of tohu. Occasionally a barometric type of scale such as -2 to +2 is utilised. Discussions around the cultural appropriateness of the different types of scale pertaining to CBM have not been found. It is assumed that most authors think there is no real difference between the different types of Likert scales. Through testing these two types in this research it was found that a -2 to +2 semantic differential scale was preferred by research team members both because such a barometer reflects the diminishing / enhancing aspects of mauri and wairua, and because they found it easier to visualise the centre of the scale. Occasional difficulties experienced by kaitiaki in rating the health of some tohu resulted in scores half way between two points. This suggests that a 7-point Likert (-3 to +3) would be a more appropriate metric.

The use of quantitative data in other CBM approaches has primarily been used for assessing the current health and, if repeat visits are undertaken, trends in the state of tohu over time. In this research the quantitative data were also used to assess the collective and individual understandings by kaitiaki, through triangulation with the qualitative data, of each tohu and how to rate their health. This is a novel use of quantitative data in CBM. In other research projects no investigations of whether monitors have a similar or different understanding of tohu were revealed.

The Ketewhaihua is as much an ako learning tool as it is a monitoring tool. The research team did not set out to develop such a tool, however the Ketewhaihua was soon identified as performing a learning function. All members of the research team voiced and documented positive personal and collective learning experiences. Roles frequently interchanged with team members helping each other work to their strengths. They expressed surprise about how much mātauranga they held as a collective though as individuals they felt their levels were mediocre. The loss of Indigenous knowledge is a phenomenon often commented upon, however it was found in this research that it is perhaps more accurately described as ‘fragmented’. All kaitiaki reported that their level of mātauranga Māori increased over the research journey, as they rebuilt this fragmented knowledge. The tool facilitated the inter-generational transfer of mātauranga Māori and traditional narratives, kaitiaki citing the Atua framework, te reo Māori, whakapapa taxonomy, whakataukī, whakatau-a-ki, and the unique and holistic perspective mātauranga Māori has to offer biodiversity conservation and management.

8.2 Strengths and weaknesses of the utility of the Ketewhaihua

With the development of the Ketewhaihua, kaitiaki around Aotearoa New Zealand have a new toolkit to add to their resource management toolbox to assist them in their practice of kaitiakitanga. The Ketewhaihua has been developed to a well-functioning state. It is trustworthy, both from cultural and scientific perspectives. It can be used to differentiate between forests and detect differences in forest health. It can be used to carry out assessments across a range of forest types and management regimes. The Ketewhaihua has been designed so that tribal groups can modify it to suit their own cultural traditions and relationships with forests. With the assistance of the Ketewhaihua, kaitiaki can easily gather and present information on their cultural values in relation to indigenous forests. The use of the Ketewhaihua by kaitiaki will enhance their ability to effectively participate and provide advice regarding the sustainable management of indigenous forests.

A major strength of the Ketewhaihua is that it provides a mechanism to improve cross-cultural communication and understanding of mātauranga Māori in relation to forest management. Like other successful CBM tools it draws upon both Indigenous and scientific ways of knowing which helps to bridge the cultural gap between different approaches. Kaitiaki reported that their experience of working directly with forest-holders increased their respect for these people and appreciate the forest guardianship roles these people hold. Undertaking forest assessments and interviews using the Ketewhaihua fosters connections and provides a pathway for building trust, relationships, cultural understanding and knowledge exchange in communities. Forest-holders also reported benefiting from the engagement. Discussions between the kaitiaki and forest-holders raised awareness about the state health of their forests and prospective solutions for improvement. The act of engagement and this awareness raising can lead to interventions by forest-holders towards improving the health of their forests. Some interventions may have effect almost immediately – not requiring analysis of results and the production of a report – such as a forest holder seeking knowledge about a tohu or aspect of their forest, efficiently effecting change.

The Ketewhaihua has been purposely designed as an integrated and holistic tool underpinned by an Indigenous Māori way of knowing. It can capture a wide breadth of information around the health of indigenous forests. Most existing toolkits for measuring the health of forests gather information that pertain directly to the ecology or biodiversity of the forest, often with implicit goals of maintaining and restoring biodiversity. The Ketewhaihua includes a wide range of tohu, including tohu outside of those which are traditionally monitored by Western science in forestry and biodiversity applications. These may not necessarily directly assess the ecological health of the forest but may be vital to the implementation and success of interventions.

CBM is a good approach to broad-based monitoring and can provide an overview of biodiversity health. The approach can detect threats, identify priority issues, suggest interventions and make recommendations on future research efforts. A weakness of CBM, which also applies to the Ketewhaihua, is that the approach is less useful for fine-scale monitoring of precise changes. This is when Western scientific methodologies can be deployed to undertake more focussed research on issues identified through CBM approaches. For example, in this research we encountered instances where there was a common lack of knowledge by forest-holders of the state of health of reptiles in the three forests. When applying the Ketewhaihua in future indigenous forest assessments this could be a trigger for more detailed investigations of the state of health of reptiles in these forests, or indeed a catalyst for a catchment or regional scientific investigation.

In scientific monitoring programmes the initial goal is often to establish an ecological baseline of current state of health from which to map the effects of environmental change over time. Increasingly this baseline data is of degraded ecosystems which is problematic when designing restoration and conservation programmes (Alagona, Sandlos & Wiersma 2012). CBM tools, including the ketewhaihua, have the potential to look back to a prior state of health of natural resources through interviewing people on their recollections to form an impression of historic ecosystem states and even in the development of the tohu which may have a basis around historical attributes of the forest ecosystem (Lyver *et al.* 2018).

8.3 Opportunities and challenges for the uptake of the Ketewhaihua

CBM is being used by tribal groups to support cultural impact assessments, monitor resource consents and very occasionally undertake long-term motoring programmes. However, Jollands and Harmsworth (2007) found that the level of participation of Māori in sustainability monitoring remains low, under-resourced, and uncoordinated. Both the barriers and the opportunities for the uptake of the Ketewhaihua come under the same two broad themes: political and technological.

In the past there has been no political recognition and support given to Māori to assert their kaitiakitanga role as guaranteed under the Treaty of Waitangi. This was due to a range of reasons from cultures talking past each other, ignorance over the value of Indigenous ways of knowing, to breaches in the Treaty of Waitangi and overt racism. Māori are increasingly asserting their rights and gaining power promulgated in no small part by the Treaty of Waitangi settlement process and a resulting increase in their economic asset base and concomitant growth in political capital. There are now legal and policy imperatives to include Māori in biodiversity monitoring, and a greater willingness to engage, at least between some authorities and some tribal groups. Well-designed

tools have the potential to collect and present information in ways that are recognisable to those in positions of authority and influence as well as to wider society.

A major challenge to implementing the outputs of this research and the uptake of the Ketewhaihua will be to secure commitment to use this approach and consistent and long-term resourcing for culturally-based monitoring programmes beyond one-off projects. The Motueka Integrated Catchment Management programme (2001 – 2010) was one example where some traction was gained when a Motueka tribal group was funded on an annual basis. A toolkit was developed and freshwater monitoring undertaken over a four year period (Harmsworth *et al.* 2011). The initiative was seen as both relevant and complementary by scientists and Māori involved in the programme. It situated kaitiaki in a more informed decision-making position. Current CBM in the Motueka catchment is however, *ad hoc* and reactive, typically being carried out as a condition of resource consent applications and ends once the development activity is complete (Daren Horne, Iwi Liaison Officer, Tiakina te Taiao, May 2017, personal communication). This is characteristic of CBM activity throughout Aotearoa New Zealand (Chetham *et al.* 2011). Recent policy initiatives such as the Environmental Reporting Act, 2015 (NZ Parliament 2015) and the National Policy Statement for Indigenous Biodiversity (Biodiversity Collaborative Group 2018) pave the way for increased opportunities for Māori to be involved in environmental management including monitoring. Embedding CBM approaches within central government environmental reporting is gaining traction (Ministry for the Environment & Stats NZ 2017,2019) which could potentially see provision made within current legislation for long-term support for CBM as part the broader gamut of monitoring New Zealand's environment.

Our research practice involved recording field notes on paper forms which were then later transferred to digital data sets. This was a cumbersome, time-consuming and a costly way to collect and collate data. Given the increasing use of smart phone applications and their accessibility to kaitiaki, there is a place for technology in the future development of the Ketewhaihua and other CBM tools. The development of 'app' technology opens opportunities for increased practice of kaitiakitanga by kaitiaki. Using such technology, it should be possible to gather data with relative ease, cost effectively and at any place and at any time, both in formal investigative and informal crowd-sourcing settings, the latter including whānau members undertaking assessments as part of everyday cultural activities. The field of 'app' development for mobile devices is rapidly advancing with many 'apps' now including integrated audio and video which better reflect the traditions of Māori and the communication of cultural narratives. Improved data analytics functionality, data display features and geospatial connectivity are also advancing at a rapid rate. It is predicted that technology could help secure support for CBM projects and programmes due to the ease and

affordability in capturing data and implementing interventions. However, there are challenges associated with the implementation of technology for the purposes of environmental monitoring particularly relating to data sovereignty, data integrity and protection, and the acknowledgement and protection of Indigenous intellectual knowledge and property.

8.4 Recommendations for further research

Building upon this thesis there are five recommendations for further research. These are (i) technical development of the Ketewhaihua, (ii) testing its ability to monitor changes in forest health over time, (iii) collaborative research with other Māori groups working in the same CBM space, (iv) development of an implementation strategy, and (v) the application of the Atua framework to other resource management and/or planning issues.

A key recommendation is that a digital version of the Ketewhaihua be developed for ease of use and efficiency gains. This could take the form of an Android app – a widespread IT platform that was common to all the research team members. The app would be designed to easily capture both qualitative data (i.e. cultural narratives, video, audio and photographs) and quantitative data. It could also include information on the traditional uses of plants and animals, ecology and health and safety, to assist kaitiaki in their practice. Safeguards would need to be in place including who has authority to supply data and who has intellectual property over that data. The app would need to be tested in the field with the six forest study sites being obvious locations for testing and kaitiaki ki Motueka as co-researchers in its development. A Government source of funding could be through the Science for Technological Innovation Challenge (SfTI) with a Ketewhaihua app being in particular alignment with the Vision Mātauranga theme and objective of integrating western science with mātauranga Māori.

The Ketewhaihua was conceived as a forest health monitoring tool and while it was tested as an assessment tool it was never tested for its monitoring capability. Time and funding constraints meant that repeat visits to the final three ‘hinterland’ forests using a fully developed Ketewhaihua was not possible. Repeat visits were carried at Puketawai, Te Maatu and Moss Reserve, however, the toolkit was in its infancy at that stage with a number of its functions still undeveloped. From this early experience the research team felt that the Ketewhaihua would be able to detect temporal changes and trends, however they were unable to confirm this. Repeat visits to the study forests would enable the testing of the longitudinal qualities of the toolkit. This research could potentially be done in conjunction with the development of the Ketewhaihua app.

The transferability and durability of the Atua framework and the Ketewhaihua across different tribal groups and geographies has also not been tested. Other kaitiaki and whānau members were invited to give feedback during the development of the toolkit. They reported good understanding and ease of its use. However, when the question was put to the research team members about their views on the transferability of the Ketewhaihua they unanimously answered that to confirm this, that this would have to be done with other Māori groups in other locations. It would make good sense to undertake collaborative work with tribal groups that are already working in the area of CBM, particularly in relation to indigenous forests to maximise learnings in this space. Likely research collaborators are Landcare Research/ Tūhoe Tuawhenua Trust who are advanced in research of cross-cultural approaches to the monitoring of forests. Ngāti Hine Forestry and Nga Uri o te Ngahere Trust are two other potential collaborators who are spearheading the move away from the current mono-culture pine forestry model to an alternative land use model that is based on native plants and trees. Ngāti Hine have already been working on the development of CBM systems in kauri forests, using an Atua framework and methodologies drawn from outputs from this research. Some of the issues they have highlighted, such as identification of flora and flora by monitors, and the need for a mobile data collection application, are the same as those identified through this research. The One Billion Trees Programme is a Government initiative to plant a billion trees by 2027. One of the stated objectives of the initiative is to 'Support Māori values and aspirations'. Currently the measure of success of the programme is based on the number of tree seedlings sold and the number of trees planted. There is an opportunity for the Ketewhaihua to be used in the monitoring of planting initiatives and the determining the success of the programme from a Māori perspective.

Uptake of the toolkit will require promotion to individuals and entities about the utility of the Ketewhaihua and its application. Opportunities for learning experiences such as wānanga and field days would be a key feature of an implementation strategy with kaitiaki involved in this research leading training programmes. Tiakina te Taiao is currently encouraging councils to include CBM as part of resource consent applications and are in discussion with the Cawthron Institute about the development of a tool for monitoring the health of the marine environment from a Māori perspective (Daren Horne, Te Ātiawa representative on Tiakina te Taiao, May 2018, personal communication). They are excited about utilising the Ketewhaihua as well as applying their learnings to the development of a marine toolbox. Other whanau groups from around the country could experience the Ketewhaihua being used in the catchment in which it was developed and take the tool home for adaption and use in their own catchments. Such experiences could be published as popular articles in the resource management magazine *Local Government* or *Te Kōmiromiro Pānui,* the Ministry for the Environment's quarterly newsletter reflecting hapū, iwi and Māori interests, to

create impact within government agencies. Online media platforms such as *Te ao Māori News* and *e Tangata,* as well as Māori television provide learning opportunities to promote kaitiaki using the Ketewhaihua and generate interest in forest management services provided by kaitiaki. For the Atua framework and ketewhaihua to reach an international audience, particularly scientists in collaborative relationships with Indigenous peoples, articles in key scientific journals would assist. Lyver, et al (2017, 2018) have published recent articles on their work with Tuawhenua in *Biodiversity and Conservation* and *Ecological Applications.* It would be prudent to publish in the same or associate journals in order to advance the international conversations and applications in the culturally based monitoring space.

The Atua framework has the potential to be transferred or adapted for other resource management or planning purposes, and even for educational training/ intergenerational knowledge transfer. One whānau member who accompanied the research team on a forest visit said that she thought that the Atua framework had potential as a planning tool, citing the development of a new kura kaupapa Māori school that she was involved with. She felt that the toolkit could be used to help create a plan of and design the school and monitor its progress in achieving cultural and environmental outcomes. As well as at the micro level the Atua framework also has the potential to be useful for planning at a macro level such as papakāinga developments. Research into the use of the Atua framework for micro and macro planning purposes is recommended.

8.5 Concluding statement

This journey has concluded. I could not have done this alone. It was a journey of personal and collective discovery. '*It's all about whanau'*[132]*.* As well as the kaitiaki on the research team and their whanau, my own family, friends and colleagues supported me. The journey was long. At times it was arduous, at other times it was broken, but mostly it was enjoyable despite the at times rough terrain. At one stage I was set back, I had to retrace my footsteps and begin the journey again. The thesis that I first submitted was not good enough to pass the muster. From that place, armed with learnings from my first attempt I reassessed my destination, set off again and have arrived at this place. This place is a destination in one sense but in another sense it is also the beginning of a new journey. Our journey, as co-researchers, was as important as the development of a tool, it was an opportunity for whanau to get together, to preform demonstrable acts of whanaungatanga, to develop respectful relationships, to korero and pass on inter-generational knowledge. This was a decolonizing way to sail the waka. It was an opportunity for kaitiaki to assert their tino

[132] This is a contemporary whakataukī which gained popularity through a government well-being initiative for Māori where individuals are supported by whanau and whakapapa.

rangatiratanga and practice kaitiakitanga with mana and empowerment. It was an opportunity to exchange bi-cultural information and share the experience of whanaungatanga with forest holders, create connections. This journey was also a journey of a tool, the Ketewhaihua. At first the kete was empty, just an idea. We placed into the basket whakapapa of the whānui of nga kaitiaki Atua. To the kete we added tohu, and mātauranga Motueka in narratives and metrics in both traditional and contemporary forms. The basket is now full and now is the time to share its wealth. *It's all about whanau.*

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Appendix 1: Culturally-based monitoring in New Zealand

Appendix 1: Culturally-based Monitoring – New Zealand review			
Author(s) and year	Domain	Name of CBM programme and website	Review of methods in and ex
(Hauraki Maori Trust Board 1999)	Fisheries	Customary indicators	
(Tipa 1999; Tipa & Teirney 2002; Tipa & Teirney 2003; Townsend *et al.* 2004; Tipa & Teirney 2006a,b; Tipa 2010)	Freshwater	Cultural Health Index https://www.mfe.govt.nz/sites/default/files/cultural-health-index-for-streams-and-waterways-tech-report-apr06.pdf	River health/ Access/ Mah 10 key indicators Likert 1 to 5 scale with qua A field tool developed by N particularly in Southland, C
(Harmsworth 2002a)	Wetlands	Māori environmental performance indicators http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.485.6751&rep=rep1&type=pdf	Pressure - State - Respons 14 key indicators Likert 1 to 5 and 1 to 3 sca A collaboratively develope
(Pauling 2004; Mattingley & Pauling 2005; Pauling & Mattingley 2007; Pauling 2010)	Freshwater	State of the Takiwā https://www.takiwa.org.nz/pages/about-takiwa.html	Toolbox includes CHI and S 8 key indicators and a mah Likert 1 to 5 scales with qu Ngai Tahu developed, and particularly Southland and
(Morgan 2004,2006,2007b,a)	Multiple	Mauri Model http://www.mauriometer.com/	Sustainability model reinte Indicators grouped by eco Mauri-o-meter semantic d Developed by a Māori scie focus on collecting quantit projects both in New Zeala
(Ngati Konohi, Department of Conservation & Ministry for the Environment 2005; Wakefield & Walker 2005; Wakefield *et al.* 2007; Wilson *et al.* 2007)	Marine	Māori methods and Indicators http://www.doc.govt.nz/Documents/science-and-technical/sap242entire.pdf	No explicit framework 8 key indicators identified Indicators toolbox collabor Ngāti Konohi, MfE and DoC No monitoring results pub

(Passl & Walker 2005; Kroos 2007; Passl 2008)	Freshwater	Iwi environmental indicators for Wai file:///C:/Users/Dean/Downloads/A%20Cultural%20Health%20Index%20for%20Reservoir%20Ck2007.pdf	Ngā Atua framework 22 key indicators within 6 Likert 1 to 5 scale Adapted CHI tool by Tiakin Wakapuaka catchments, N
(Pauling *et al.* 2007)	Estuarine	State of the Takiwā http://www.cleanwaterways.org.nz/pdf/state-of-the-takiwa-report-2007.pdf	Toolbox also includes CHI 6 key indicators and a mah Likert 1 to 5 scales with qu Ngai Tahu developed, and Avon-Heathcote estuary. D
(Kennedy & Jefferies 2007; Jefferies & Kennedy 2009b)	Multiple, trials involved freshwater	Kaupapa Māori outcomes and indicators framework and kete https://researchcommons.waikato.ac.nz/handle/10289/895	PUCM Kaupapa Māori Fran 41 indicators within 3 kete Likert 1 to 5 scale The tool has been trialled
(Pauling & Arnold 2008) (Te Rūnanga o Arowhenua, Pauling & Norton 2010)	Lakes	State of the Takiwā http://www.wet.org.nz/wp-content/uploads/2009/10/Ch08-Cultural-health-of-the-lake1.pdf	Takiwā monitoring form Tool also includes CHI and 6 key indicators and a mah Likert 1 to 5 scale with qua Developed and applied too Ellesmere and Otuwhareka
(Rickard & Swales 2009b,a)	Estuarine	Nga Waihotanga Iho –The Estuary Monitoring Toolkit for Iwi https://www.niwa.co.nz/te-kuwaha/tools-and-resources/ng%C4%81-waihotanga-iho-the-estuary-monitoring-toolkit	Scientific framework to be mapping, sediment, plants Various indicators have be It is a science-based tool, c “complementary to traditi
(Walker 2009)	Estuarine	Iwi indicators for estuaries http://envirolink.govt.nz/assets/Envirolink/628-nlcc31.pdf	Ngā Atua framework 24 key indicators within 6 Likert 1 to 5 scale with qua Developed by Tiakina te Ta Motueka region. It has sinc Āhuriri Inc. in Napier.
(National Institute of Water and Atmosphere 2010)	Freshwater	Cultural Health Index http://www.mfe.govt.nz/publications/fresh-water/waikato-river-independent-scoping-study	Report cards Up to 167 indicators acros A to E Likert scale with qua Trialled but not developed

(Young *et al.* 2010; Harmsworth *et al.* 2011)	Freshwater	Māori environmental monitoring and cultural indicators http://icm.landcareresearch.co.nz/knowledgebase/publications/public/Cultural_indicators_report2.pdf	Ngā Atua framework 22 indicators spread acros 1 to 5 Likert scale with qua Developed by manawhenu Motueka Integrated Catch Tiakina to monitor some re
(Shortland 2011b)	Forests	Cultural indicators for kauri ngahere https://www.kauridieback.co.nz/media/1367/monitoring-kauri-cultural-health-shortland-et-al-2011.pdf	No framework has not bee necessary for utilising indi 43 indicators have been id minor vegetation, trees, in Recommendations for a m tools have been developed
(Ruru 2014)	Marine/ Freshwater	Mauri compass https://www.mauricompass.com/	Tāne, Tangaroa & Tangata 12 indicators contained wi Mauri assessment tool dev Council, and some iwi and
(Lyver *et al.* 2017)	Forests	An indigenous community-based monitoring system	Values-based framework 25 indicators grouped acc 1 to 7 Likert scale and qua Results of monitoring have

Note: A CHI framework has been modified for a Coastal version and is in use in Northland (Chetham *et al.* 2010)

Appendix 2: Tohu Ngahere Data Collection Form (Version 8)

Kaitiaki[133]:	Forest Name:	Date:	Logged[134]:	Data Logger[135]:

This tohu ngahere (forest indicators) form and method is part of a Ketewhaihua (tool kit) intended to be used by kaitiaki to help assess and monitor the health of indigenous forests from a cultural perspective. The Ketewhaihua can be used for a variety of purposes in a wide range of situations including Māori forest lands, the public estate or privately-owned forests. Issues around mātauranga Māori, the storage of data and who has access to the information should be made explicit prior to entering the field. This is a guide only and kaitiaki are encouraged to modify the method to suit. A map or aerial photo of the forest under assessment should be provided to kaitiaki in either digital or hardcopy form.

Method/ kawa

1. Observations begin as soon as the catchment is entered.
2. Carry out appropriate tikanga and, health and safety protocols.
3. Discuss the reasons behind carrying out the assessment or monitoring of the forest and its timing[136].
4. Take a walk as a group through the forestland being assessed. The walk should be sufficiently long as to cover a representative area of the forest and acknowledge appropriate Atua. A 30-minute walk for a small forest (< 20 hectares) or 1 hour for a medium sized forest (> 20 hectares) as a minimum[137].
5. Acknowledge Papatūānuku and Ranginui, and their uri Tangaroa, Tāne, Tāwhirimātea, Tū, Haumie, Rongo and Rūaumoko, as well as any specialised secondary Atua along the walk. Atua, the forms they take and the tohu contained in their kete will vary across individual kaitiaki, hapū and iwi. Change these to suit your cultural and contextual reality.
6. Following the walk gather as a group. A nominated person facilitates the kōrero. Tohu ngahere and the health of each indicator is discussed in turn and forms are completed either individually[138] or collectively[139]. Relevant Atua, species, keywords and whakataukī are identified by the group for each tohu indicator[140]. These act as a

[133] Full name of person filling out the form
[134] For office use – tick and date of data logged into the system e.g. GIS or other database
[135] Name of person logging data into the system
[136] The timing of the assessment can be associated with a seasonal event
[137] These figures are for repeat visits. Initial visits tend to be longer.
[138] One form per person – advisable when the team is learning/ developing the ketewhaihua
[139] One form per team – advisable when the kete has been learned / developed by the team
[140] Examples are given in this form. These are relevant to this group and the development of the tool but it is expected that other groups will have their own Atua, species, keywords, whakataukī and kōrero relevant to their own cultural and and contextual reality.

prompt for discussion. Examples are provided for each indicator, however kaitiaki are encouraged to change the tohu ngahere examples to suit their own cultural reality. The main aim is to have a robust discussion around each tohu. Individuals should be free to influence or be influenced by other members of the group or be staunch in their position. It may be worthwhile making an audio or video recording to acknowledge the oral tradition, inform future generations and help verify the written discussion. Each kaitiaki is expected to make qualitative notes. Whakatauākī and poetic forms are encouraged to get to the essence or highlight the complexity of the kōrero.

7. The condition of the tohu is also quantitatively rated using a numerical scale. Not scoring a tohu is acceptable but should be circled as NS. If the condition of the tohu changes during the course of monitoring (e.g. more birds arrive) or new information comes to light the data needs be changed by the kaitiaki to reflect this change.
8. Issues and action points are discussed as a collective and documented at the end under 'Recommendations'. Checking the low and high scores by kaitiaki is a good prompt.
9. It is recommended that both data and feedback forms are held by kaitiaki for a period of a few days to give them time to reflect on their data and complete feedback forms.

Forest Location	**Forest type and stage of development**[141]
Landholder(s)[142]	**Other whānau and manuhiri**[143]
Tikanga[144]	**Land use**[145]
Adjacent land use[146]	**Seasonal Indicator**[147]
Cultural relationship[148]	**Weather**[149]
Maramataka/ moon phase[150]	**Other**[151]

TANGAROA	
1. Te Ihorangi[152] **Tohu**: Water clarity **Keywords**: murky, clear	**Whakataukī:** *Wai para hoanga*. 'Grinding-stone refuse water.' Water so discoloured by the use of a grinding-stone **Kōrero/ whakatauākī**[153]:

murky				crystal clear
ns	-2	-1	0	1	2

2. Parawhenua	**Whakataukī**: *E kore a Parawhenua e haere, ki te kore a Rakahore*. 'Parawhenua would not flow if it were not for Rakahore.' The joining of

[141] e.g. podocarp, beech, mixed e.g. mature (virgin), secondary (regrowth), regeneration
[142] Note agency or, if private forest, contact person
[143] Other kaumātua, mokopuna, or guests, etc. accompanying kaitiaki. Their attendance is encouraged to enable intergenerational transfer of mātauranga Māori
[144] The tikanga associated with monitoring will vary according to the kawa of the iwi groups involved, e.g. karakia, mauri stone, mauri tree, abstinence (of smoking/ eating) during the monitoring period, etc. A general note of tikanga only is required.
[145] Note current land use, e.g. preservation, picnic area, eco-tourism, production forest
[146] Note use of lands immediately adjoining forest
[147] Traditional monitoring of ngahere was carried out around time of harvest or natural forest event, e.g. Matariki, flowering of tī kouka, return of the pīpīwharauroa (shining cuckoo), beech mast (flowering), etc.
[148] Notes on the cultural nature of the site e.g. Pa site, kāinga, mahinga kai, ara (trail), etc.
[149] General weather observation (e.g. fine and warm)
[150] Maramataka (lunar calendar) guidance particularly in relation to forest or birding activities.
[151] Addition notes around monitoring i.e. forest-holder interview, forestry or council staff in attendance, learning highlight of the day, etc.
[152] These secondary Atua are those associated with a specific role or species. Examples cited here have been identified through the literature. They are not necessarily indicative of Atua who whakapapa to your iwi, they are merely illustrative. If you know Atua associated with your iwi cite these instead
[153] Short comment or poetic statement which reflects your observation of the state of the tohu.

Tohu: Water flow **Keywords:** water and stone, flow, diversity, pools, riffles, rapids,	Parawhenua, of water and Rakahore, of stone symbolises the interdependence of different life forms. **Kōrero/ whakatauākī:**
flow is dead ns -2	some diversity of flow -1 0	many pools, riffles and rapids 1 2
3. Kaukau **Tohu**: Water quality **Keywords**: children of Wainui, swim, fish, drink **Note Species**:	**Whakataukī:** *Na wai i tara te wai?* Who stirred the waters (and caused the quarrel)? **Kōrero/ whakatauākī:**
waimate ns -2	waikino -1 0	waimāori 1	waiora 2
4. Moetahuna **Tohu**: Water life, fish, eels, water fowl **Keywords**: potential, quantity, quality **Note species:**	**Whakataukī**: *Me te whata raparapa tuna e iri ana te tutu.* 'The Tutu berries are hanging like split eels.' When the tutu is laden with berries the eel hunt has finished. **Kōrero/ whakatauākī:**
little life ns -2	hidden -1 0	abundant 1 2
5. Punga[154] **Tohu**: Insects **Keywords**: sound, in-flight **Note species**:	**Whakataukī**: *E kita nei hoki te tatarakihi.* 'Singing just like a cicada.' Refers to food stocks being ample **Kōrero/ whakatauākī:**
little life ns -2	not around -1 0	abundant 1 2

[154] Also Torohua

6. Tūtewehiwehi[155] **Tohu**: Reptiles **Keywords**: habitat, stone, quantity **Note species**:	**Whakataukī**: *Ko te tini o Ruaūmoko*. 'The many of Ruaūmoko.' This is a figurative way of referring to reptiles. **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	
TĀNE	
7. Punaweko[156] **Kerangi**[157]**, Tūmataika**[158] **Tohu**: Forest kaitiaki[159] **Keywords**: Iconic species, numbers, heard, seen, health **Note species**:	**Whakataukī**: *Na, ko Punaweko, ko Tāne-te-hokahoka, ko Hurumanu*[160]*, ko enei nga putake mai o te manu, ahakoa i te rangi, i te whenua ranei, ko ratou nga pou o enei.* 'Punaweko, Tāne-te-hokahoka and Hurumanu are the source of the birds, whether in the heavens or on earth, and they sustain them.' Used to describe the origins of land and sea birds. **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	
8. Parauri **Tohu**: Nectar eater **Keywords**: song, nectar, honey, harvest level = +2 **Note species**:	**Whakataukī**: *He korokoro tūī*. 'The throat of a tūī.' Used to describe the chatting of a tūī or singing and speech making. **Whakatauākī:** *Tangi taiawhio te rongo koro tūī - 'Rongo reka rawa'*. **'**Tūī singing in the background, 'Song full of honey''. JK **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	

[155] Also Peketua.+ Tū-te-wanawana
[156] Punaweko is a generic Atua of forest birds.
[157] of raptor species
[158] of parrot species
[159] An iconic species is identified by the team as the forest's kaitiaki
[160] Also Hurimanu

9. Rupe **Tohu**: Fruit eater **Keywords**: fruit, harvest level = +2 **Note species:**	**Whakataukī**: *Me te rau rangiora*. ‘Like the leaves of the rangiora.’ When many wood pigeons were seen or collected they were compared with rangiora leaves. **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	
10. Haere-awaawa **Tohu**: Ground bird, ‘extinct’ birds **Keywords**: harvest level = +2 **Note species**:	**Whakataukī**: *Ko te manu huna a Tāne.* ‘The hidden bird of Tāne.’ This is a proverbial term for the kiwi who hides in the forest. **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	
11. Tāne-te-hokahoka **Tohu**: Small birds **Keywords**: song **Note species**:	**Whakataukī**: *Ko Tāne-te-hokahoka nana te manu rikiriki.* ‘Tāne-the-soaring-one who brought forth the small birds.’ This is an old saying crediting Tāne with the origins of small birds. **Kōrero/ whakatauākī:**
none seen pair seen many seen ns -2 -1 0 1 2	
12. Hurumanu **Tohu**: Bird pathways **Keywords**: flight, song, connectivity, corridor, hub **Note Species**:	**Whakataukī**: *Te mara o Tāne*. ‘The garden of Tāne.’ This is an expression of bird song and alludes to forest foods found in abundance and the flight path of birds. **Kōrero/ whakatauākī:**

isolated one connection few connections many connections hub ns -2 -1 0 1 2	
13. Hine-waoriki[161] **Tohu**: Emergent trees **Keywords**: windfalls, salvage, harvest level = +2 **Note species**:	**Whakataukī**: *He taru kahikatea*. 'The shaking of a kahikatea.' This is a metaphor for a light summer rain, which symbolises seedlings or emergent trees. If an individual was to see an abundance of emergent trees, it was perceived as if the kahikatea had rained down upon the earth spreading it seed. **Kōrero/ whakatauākī:**
none seen few seen many seen ns -2 -1 0 1 2	
14. Mumuhanga[162]**, Takapua**[163]**, Mangonui**[164] **Tohu**: Canopy trees **Keywords**: condition, windfalls, salvage, harvest level = +2 **Note species**:	**Whakataukī**: *Ko te maramara a Tu-kau-moana.* 'The wood chip of Tu-kau-moana.' Mumuhanga in her guise as Tu-kau-moana mated with Tāne to produce the tōtara. This proverb refers to the abundant resources obtained from the tōtara. **Kōrero/ whakatauākī:**
none seen few seen many seen ns -2 -1 0 1 2	
15. Rerenoa[165] **Tohu**: Climbing plants **Keywords**: **Note species**:	**Whakataukī**: *E, kei whawhati noa mai i te rau o te rata*. 'Ah, don't pluck the blossoms of the rata.' Some things are beautiful as they are and nothing we can do will improve them. **Kōrero/ whakatauākī:**

[161] Atua of kahikatea and mataī. Also Hine-te-ngawari
[162] Atua of tōtara. Also Momohanga, also Mūmūwhango
[163] Atua of beech (tāwhai)
[164] Atua of tawa and hinau
[165] Also Toro-i-waho

	none seen		few seen		many seen
ns	-2	-1	0	1	2
16. Rurutangiakau[166] **Tohu**: Understory and regeneration **Keywords**: Regeneration condition/ development, harvest level = +2 **Note species**:	**Whakataukī**: *He iti, he iti kahikatoa,* Though small it is still a mānuka tree. This tree supplies strong and tough material for tools and weapons as well as nectar for medicinal honey. **Kōrero/ whakatauākī:**				
	none seen		a little seen		much seen
ns	-2	-1	0	1	2
17. Tanga-i-waho **Tohu**: Catchment vegetation **Keywords**: diversity, connectivity **Note species**:	**Whakataukī**: *Ki uta ki tai*. 'From the mountains to the sea'. Refers to the connections between the mountains and the ocean within a catchment **Kōrero/ whakatauākī:**				
	single exotic species		mixture of native and exotic		all native species
ns	-2	-1	0	1	2
18. Te Wao-tu-rangi **Tohu**: Bush size and shape **Keywords**: narrow, wide **Note size** (ha.): **Note species**:	**Whakataukī:** *Te Wao nui o Tāne*. 'The sacred forest of Tāne.' **Kōrero/ whakatauākī:**				
	skinny				hapu
ns	-2	-1	0	1	2
19. Maiki-roa **Tohu**: Pests and weeds	**Whakataukī** *E ngaki ana a mua, e toto ana a muri.* 'First clear off the weeds, then plant.' In order to promote growth, one must first clear the way. **Kōrero/ whakatauākī:**				

[166] Atua of mānuka and ake ake. Also Tawake-toro Atua of mānuka.

Keywords: usefulness, problem, growth**,** homeland kaitiaki[167] **Note species**:	
overrun	stable none
ns -2	-1 0 1 2
TĀWHIRIMĀTEA	
20. Piro **Tohu**: Smell of the forest **Keywords**: chemical smell, earthy, sweet, sour **Note species**:	**Whakataukī**: *He moenga rangatira he moenga kākāra, he moenga ware he moenga haunga.* 'The resting place of a chief is fragrant, while those of commoners are malodorous.' This refers to the aromatic scents that were common in days past. In other words, if a place is well kept then it will not smell. **Kōrero/ whakatauākī:**
earthy smell	neutral chemical smell
ns -2	-1 0 1 2
21. Tānerore **Tohu**: Climate Change **Keywords**: Species on the edge, range extending, range diminishing **Note species on the edge of its climatic zone**:	**Whakataukī**: *Te haka a Tānerore*. 'The dance of Tānerore.' Tānerore is the son of Tama-nui-te-ra and Raumati, who is seen quivering during the heat of the day. The sun is responsible for the change in climate and it is he who sends forth Tānerore and others to relay this information to individuals. **Kōrero/ whakatauākī:**
diminishing	stable extending
ns -2	-1 0 1 2
TŪ	
22. Te Akaaka-matua **Tohu**: Tino rangatiratanga	**Whakataukī**: *He mate kahu korako*. 'Desire for the hawk with light plumage.' Such a rarely seen hawk was used as a metaphor to describe something of chiefly status. **Kōrero/ whakatauākī:**

[167] For example possums are culturally significant to Australian Aboriginals.

Keywords: Sovereignty, Self-determination **Note species**:	
low moderate high ns -2 -1 0 1 2	
23. Tumatakaka **Tohu**: Kaitiakitanga **Keywords**: Guardianship, Ability to exercise kaitiakitanga and have influence over forest management	**Whakataukī**: *Ehara taku toa i te toa takitahi, Engari he toa takitini.* 'Success is not the work of one, but the work of many.' *E raka te maui, e raka te matau.* 'The right hand is adept, the left hand is skilful.' Both whakataukī mean that it takes a community of skilled people to complete a project. **Kōrero/ whakatauākī:**
low moderate high ns -2 -1 0 1 2	
24. Hine-te-iwaiwa **Tohu**: Whānaungatanga **Keywords**: Relationships between people, the physical forest and the spiritual world	**Whakataukī**: *He punga i mau ai*. 'An anchor that holds.' A metaphor for a woman as the anchor of the family. **Kōrero/ whakatauākī:**
weak moderate strong ns -2 -1 0 1 2	
25. Hine-rauwharangi **Tohu**: Manaakitanga **Keywords**: Ability of forest to provide traditionally harvested products to iwi and their visitors **Note species**:	**Whakataukī**: *He kai na te ringaringa whero i taka*. 'Food cooked by the hand of a chief.' The hand of a chief would not normally be associated with the task of cooking. Hence, it suggests the ultimate in honour for one's guest (manaaki). **Kōrero/ whakatauākī:**
low moderate high ns -2 -1 0 1 2	
26. Tū-ringa-raupa	**Whakatauki**: *Ma te ringa raupa, ka tutuki te moemoea* 'Through hard work, dreams are achieved'.

Tohu: Economic return **Keywords**: burden, blessing, ability of forest to pay for itself, restoration, development	
low	breaking even high
ns -2	-1 0 1 2
27. Hine-raukatauri **Tohu**: Recreation use **Keywords**: Refresh	**Whakataukī**: *Ka kawea tatau e te rehia*. 'Pleasures are attractive.' This is in reference to the pursuit of pleasure or recreation. **Kōrero/ whakatauākī:**
poorly used	neutral well-used
ns -2	-1 0 1 2
RONGO	
28. Wainui[168] **Tohu**: Relationship with surrounding land use **Keywords**: Linkages between forest and other land uses. Health of forest edge. Fences. **Note Species:**	**Whakataukī**: *Harahara aitu, harahara a tai*. 'Calamity on land, ruination at sea.' Complete disaster or loss of resources; hence care around the effects of agriculture and other land uses on the environment. **Kōrero/ whakatauākī:**
hard edge	soft edge integrated
ns -2	-1 0 1 2
29. Uepoto **Tohu**: Rongoa/ medicinal plants **Keywords**: Quantity, quality **Note species**:	**Whakataukī**: *Haere e whai i te waewae o Uenuku, kia ora ai te tangata*. 'Go search for the footprints of Uenuku so that humankind may be nurtured. Uenuku was said to have been a very wise person from whom one could learn the secrets of health, personal safety and welfare. **Kōrero/ whakatauākī:**

[168] Also Huna

low	moderate high
ns -2	-1 0 1 2
HAUMIE	
30. Tahu **Tohu**: Mahinga kai levels **Keywords**: Traditional forest products support the well-being of the people **Note species**:	**Whakataukī**: *Ka kii te piro o nga manu, o nga tangata ka kata*. 'When the gut is full, both men and birds are happy.' This refers to a good healthy mahinga kai, feasting and rejoicing when food is plentiful. **Kōrero/ whakatauākī:**
little	some traditional levels
ns -2	-1 0 1 2
31. Rua-te-pupuke[169] **Tohu**: Harvest rights **Keywords**: Right to access forest and harvest materials **Note species**:	**Whakataukī**: *He kai kei aku ringa.* 'There is plenty with my hands.' This proverb refers to the ability to access and harvest the many products provided by both land and sea, including the body mind and soul. **Kōrero/ whakatauākī:**
difficult	easy
ns -2	-1 0 1 2
RUAŪMOKO	
32. Ruaroa **Tohu**: Erosion **Keywords**: Natural erosion, human induced erosion **Note species**:	**Whakataukī**: *Nga kerikeringa o Ruaumoko*. 'The digging of Ruaumoko.' This refers to erosion caused by Ruaumoko and the forming of banks, slips, holes etc. **Kōrero/ whakatauākī:**

[169] Also Rua-pupuke, also Rua-i-te-pukenga

	heavy		light		none
ns	-2	-1	0	1	2
33. Hine-one[170] **Tohu**: Soils **Keywords:** barren, fertile, types of **Note species**:	**Whakataukī:** **Kōrero/ whakatauākī:**				
	poor				rich
ns	-2	-1	0	1	2
MAURI - WAIRUA					
34. Te Kuwhatawhata **Tohu**: **Feeling in the puku** **Keywords**: Overall feeling of the mauri and wairua of the forest	**Whakataukī**: *He kiri ki waho, he puku ki roto*. 'Skin on the outside, a stomach within' - meaning don't always trust in outward appearances, for underneath lies the cause of what's taken place. In other words trust in your instincts and feelings. **Kōrero/ whakatauākī:**				
	weak				strong
ns	-2	-1	0	1	2

[170] Atua of sand and friable soil

SUMMARY OF ASSESSMENT

To:

Positive points (check high scores):

Negative Issues (check low scores):

Advice/ recommendations/ action points:

Check list: Pease tick when completed

Forest details		Kōrero/scores		Highs/lows		Recommendations	

Appendix 3: Kaitiaki Feedback Form (version 7)

Toitū te Whenua, matatū ana te wao: Cultural Health Monitoring and Assessment Techniques for Indigenous New Zealand Forests.

Date: **Round:** **Name (optional):**

This project involves the development of a Ketewhaihua for the monitoring and assessment of the health of indigenous forests from an indigenous perspective. It is an iterative process and we are always seeking improvements, both to the tool and the research process. This takes the form of kōrero and is documented on the data sheet as comments and a scale of measurement. The purpose of this feedback form is to inform the research team as to whether or not the project is heading in the right direction. Take your time to consider the following items.

1: Comments on the *tikanga* of the process of using the Ketewhaihua including aspects of

- kawa – protocols around the method
- tapae[171] - mauri tree
- tohu pure[172] - karakia to the forest
- and tapu[173] - state of being (body and mind) when monitoring

Do you have any suggestions for improvements?

Rate the kawa/ tikanga of the Ketewhaihua

1 inappropriate 2 less than appropriate 3 needs some work 4 getting there 5 spot on

[171] Dedication involved offering up a person, place or thing (often a stone hence mauri stone) to the service of the deity. The person, place or thing was now tapu.
[172] Consecration, an act of praise, a rite, karakia
[173] Tapu – a sacred state in which the rites are carried out. At the conclusion to counteract the effects of tapu pure purification rites are performed to cleanse the kaitiaki from tapu, neutralise tapu and propitiate the gods. This was normally water (Te Wai o Rehua) or cooked food.

2: Comments on the ngahere tohu to date.

- are the tohu culturally appropriate,
- do they acknowledge relevant Atua,
- are the whakataukī appropriate and relevant,
- do the indicators provide an insight into changes and trends in forest health,
- are they holistic and cover sufficient range,
- are there too many or too few,
- are there indicators that are difficult to understand, which one(s)?

short answers here

Do you have suggestions for improvements?

Rate the tohu of the Ketewhaihua. Is the current list of culturally based environmental indicators …?

1 inappropriate 2 less than appropriate 3 needs some work 4 getting there 5 spot on

3: Comments on the *Ketewhaihua* to date.

- Are there any problems in relation to the method
- Are there any problems in relation to the data collection form
- Do you have any suggestions for improving the method and data collection

Rate the Ketewhaihua method and data collection form on its difficulty or ease of use and understanding.

1 very difficult 2 difficult 3 still needs some work 4 getting there 5 easy

4: Comments on the ability of the Ketewhaihua to express and hold *Māori values*

- tikanga base
- based on *mātauranga Māori*[174]
- meaningful to tangata whenua
- appropriate kaupapa Māori method of data collection and recording

The ability of the Ketewhaihua to express and hold Māori values

1 very poor 2 poor 3 still needs some work 4 getting there 5 excellent

5: Comments on the ability of the Ketewhaihua to be *repeatable* and *capture diversity* over

- seasons
- land holders
- land uses
- personalities (kaitiaki)
- repeatable over a wide range of situations

Can you identify problems and/ or have suggestions for solving issues?

Ability of the kete to capture variations over seasons, land holders, and land uses is

1 very poor 2 poor 3 still needs some work 4 is getting there 5 excellent

6: Comments on the *principal researcher's* ability

[174] Traditional ecological knowledge

- to be part of a team,
- engage with the group,
- his knowledge of and respect for Māori cultural
- his trustworthiness
- his professional ability, etc.

How would you rate the principal researcher's ability to date?

1 struggling 2 fair 3 still needs some work 4 getting there 5 excellent

7: Comments on your *own learning* cycles.

- your knowledge of mātauranga Māori
- your contribution to the team
- Tuakana – teina learning

Where do you rate your own learning cycle? Perhaps think of it as an unfurling frond.

1 struggling 2 fair 3 still needs some work 4 getting there 5 excellent

8: Do you have any *other suggestions* about the future of this research?

- improving the research process
- improving the rigour if the Ketewhaihua
- improving the use of the kete (e.g. technology)
- getting it out there being used by iwi groups around New Zealand

Appendix 4: Mean and range of scores for the three study forests

SITE: Kākā Hill		
TANGAROA	**Av. Score**	**Range**
1. Te Ihorangi - Water clarity	0.67	-1 to 2
2. Parawhenua - Water flow	1.33	.5 to 2
3. Kaukau - Water quality	0.67	-0.5 to 1.5
4. Moetahuna - Water life	0.17	-1.5 to 1
5. Punga - Insects	1.25	.25 to 2
6. Tū-te-wehiwehi - Reptiles	-0.33	.-1 to 1
TĀNE MAHUTA		
7. Kerangi - Iconic bird	-0.33	-1.5 to 1.5
8. Parauri - Nectar eaters	-0.33	-1 to 0.5
9. Rupe - Fruit eaters	0.00	-.5 to 0.5
10. Haere-awaawa - Ground birds	-1.25	-2 to -.5
11. Tāne-te-hokahoka - Small birds	0.63	.25 to 1
12. Hurumanu - Bird pathways	0.83	.5 to 1
13. Hine-waoriki - Emergent trees	1.50	1 to 2
14. Takapua - Canopy trees	2.00	0
15. Rerenoa - Climbing plants	0.25	0 to .5
16. Rurutangiakau - Regeneration	2.00	0
17. Tanga-i-waho - Catchment vegetation	-0.58	-1.75 to 0
18. Te Wao-tu-rangi - Bush size and shape	1.83	1.5 to 2
19. Maiki-roa - Pests and weeds	-0.17	-0.5 to 0
TAWHIRIMATEA		
20. Piro - Smell of the forest	1.50	1 to 2
21. Tānerore - Climate	0.50	0 to 1
TUMATAUENGA		
22. Te Akaaka-matua - Tino rangatiratanga	1.33	0 to 2
23. Tumatakaka - Kaitiakitanga	1.33	.5 to 2
24. Hine-te-iwiwa - Whānaungatanga	1.50	1 to 2
25. Hine-rauwharangi - Manaakitanga	1.00	0
26. Tu-ringa-raupa - Economic return	0.83	0 to 1.5
27. Hine-raukatauri - Recreation Use	1.17	0 to 2
RONGO MATĀNE		
28. Wainui - Relationship with surrounding land use	0.00	-1 to 1
29. Uepoto - Rongoa/ medicinal plants	1.17	0 to 2
HAUMIATIKETIKE		

30. Patekateka - Mahinga kai	0.33	0 to 1
31. Rua-te-pupuke - Harvest rights	-0.17	-1.5 to 1
RUAUMOKO		
32. Ruaroa - Erosion	0.50	0 to 1
33. Hine-one - Soil condition	1.00	0 to 1.5
WAIRUA/ MAURI		
34 Te Kuwhatawhata - Feeling in the puku	1.67	1 to 2

SITE: Te Kāinga Tawhai		
TANGAROA	**Av.Score**	**Range**
1. Te Ihorangi - Water clarity	0.17	-1 to 1
2. Parawhenua - Water flow	2.00	0
3. Kaukau - Water quality	1.17	0 to 2
4. Moetahuna - Water life	1.33	1 to 1.5
5. Punga - Insects	1.00	0
6. Tū-te-wehiwehi - Reptiles	-0.33	-1 to 1
TĀNE MAHUTA		
7. Kerangi - Iconic bird	1.33	1.5 to 1
8. Parauri - Nectar eaters	1.50	0
9. Rupe - Fruit eaters	0.50	0 to 0.5
10. Haere-awaawa - Ground birds	-0.50	0
11. Tāne-te-hokahoka - Small birds	0.67	1 to 0
12. Hurumanu - Bird pathways	1.08	1.25 to 1
13. Hine-waoriki - Emergent trees	1.50	1 to 2
14. Takapua - Canopy trees	1.50	1 to 2
15. Rerenoa - Climbing plants	0.83	0 to 1.5
16. Rurutangiakau - Regeneration	1.83	1.5 to 2
17. Tanga-i-waho - Catchment vegetation	0.75	0.5 to 1
18. Te Wao-tu-rangi - Bush size and shape	2.00	0.00
19. Maiki-roa - Pests and weeds	0.67	0 to 1
TAWHIRIMATEA		
20. Piro - Smell of the forest	1.67	1.5 to 2
21. Tānerore - Climate	1.83	1.5 to 2
TUMATAUENGA		
22. Te Akaaka-matua - Tino rangatiratanga	1.75	1.5 to 2
23. Tumatakaka - Kaitiakitanga	1.83	1.5 to 2
24. Hine-te-iwiwa - Whanaungatanga	1.67	1 to 2
25. Hine-rauwharangi - Manaakitanga	1.33	1 to 1.5

26. Tu-ringa-raupa - Economic return	0.00	-2 to 1
27. Hine-raukatauri - Recreation Use	1.33	1 to 2
RONGO MATĀNE		
28. Wainui - Relationship with surrounding land use	1.50	1 to 2
29. Uepoto - Rongoa/ medicinal plants	1.17	1 to 1.5
HAUMIATIKETIKE		
30. Patekateka - Mahinga kai	0.00	0.00
31. Rua-te-pupuke - Harvest rights	1.00	0 to 2
RUAUMOKO		
32. Ruaroa - Erosion	0.33	0 to 0.5
33. Hine-one - Soil condition	1.33	1 to 1.5
WAIRUA/ MAURI		
34 Te Kuwhatawhata - Feeling in the puku	2.00	0.00

SITE: Brewerton's Forest		
TANGAROA	**Av.Score**	**Range**
1. Te Ihorangi - Water clarity	0.33	0 to 1
2. Parawhenua - Water flow	0.83	0 to 2
3. Kaukau - Water quality	0.50	0 to 1.5
4. Moetahuna - Water life	-0.08	-0.5 to 0.5
5. Punga - Insects	1.33	0.5 to 2
6. Tū-te-wehiwehi - Reptiles	-0.75	-1 to -0.5
TĀNE MAHUTA		
7. Kerangi - Iconic bird	1.00	0.00
8. Parauri - Nectar eaters	0.67	0 to 1
9. Rupe - Fruit eaters	-0.50	-2 to 0.5
10. Haere-awaawa - Ground birds	-0.17	-1.5 to 0.5
11. Tāne-te-hokahoka - Small birds	1.17	1 to 1.5
12. Hurumanu - Bird pathways	0.67	0 to 1
13. Hine-waoriki - Emergent trees	1.17	0.5 to 2
14. Takapua - Canopy trees	1.50	1 to 2
15. Rerenoa - Climbing plants	-1.67	-2 to -1
16. Rurutangiakau - Regeneration	0.83	0.5 to1
17. Tanga-i-waho - Catchment vegetation	0.17	0 to 0.5
18. Te Wao-tu-rangi - Bush size and shape	0.17	-1 to 1.5
19. Maiki-roa - Pests and weeds	0.17	0 to 0.5
TAWHIRIMATEA		
20. Piro - Smell of the forest	0.17	-1 to 1.5

21. Tānerore - Climate	-0.08	-0.5 to 0.25
TUMATAUENGA		
22. Te Akaaka-matua - Tino rangatiratanga	0.00	0.00
23. Tumatakaka - Kaitiakitanga	0.00	0.00
24. Hine-te-iwiwa - Whanaungatanga	0.33	0 to 1
25. Hine-rauwharangi - Manaakitanga	0.83	0 to 2
26. Tu-ringa-raupa - Economic return	0.50	0 to 1
27. Hine-raukatauri - Recreation Use	0.33	0 to 1
RONGO MATĀNE		
28. Wainui - Relationship with surrounding land use	0.83	0.5 to 1.5
29. Uepoto - Rongoa/ medicinal plants	0.00	0.00
HAUMIATIKETIKE		
30. Patekateka - Mahinga kai	-0.17	-1 to 0.5
31. Rua-te-pupuke - Harvest rights	0.50	-0.5 to 1
RUAUMOKO		
32. Ruaroa - Erosion	0.67	0 to 1
33. Hine-one - Soil condition	-0.33	-1 to 0
WAIRUA/ MAURI		
34. Te Kuwhatawhata - Feeling in the puku	1.17	1 to 1.5